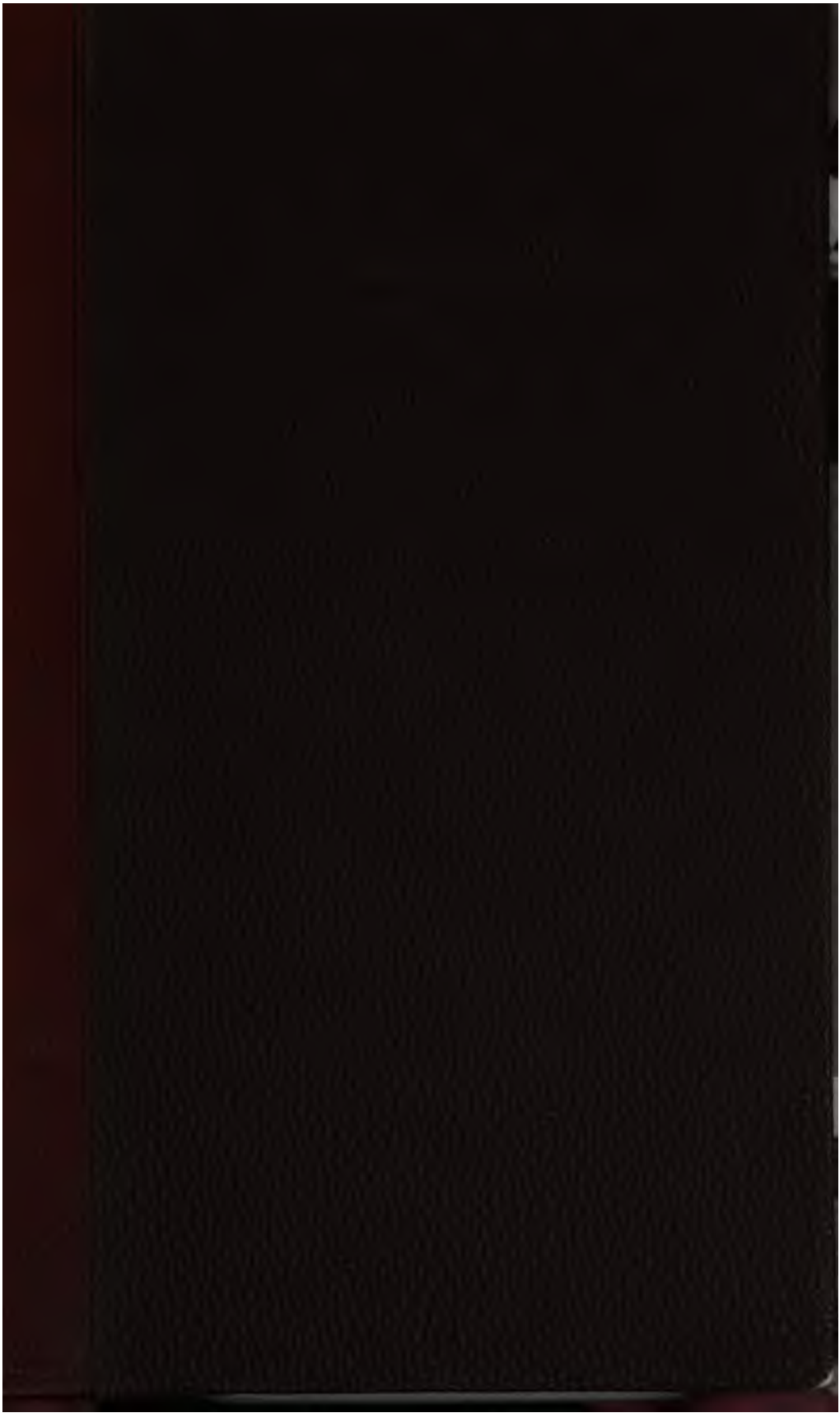

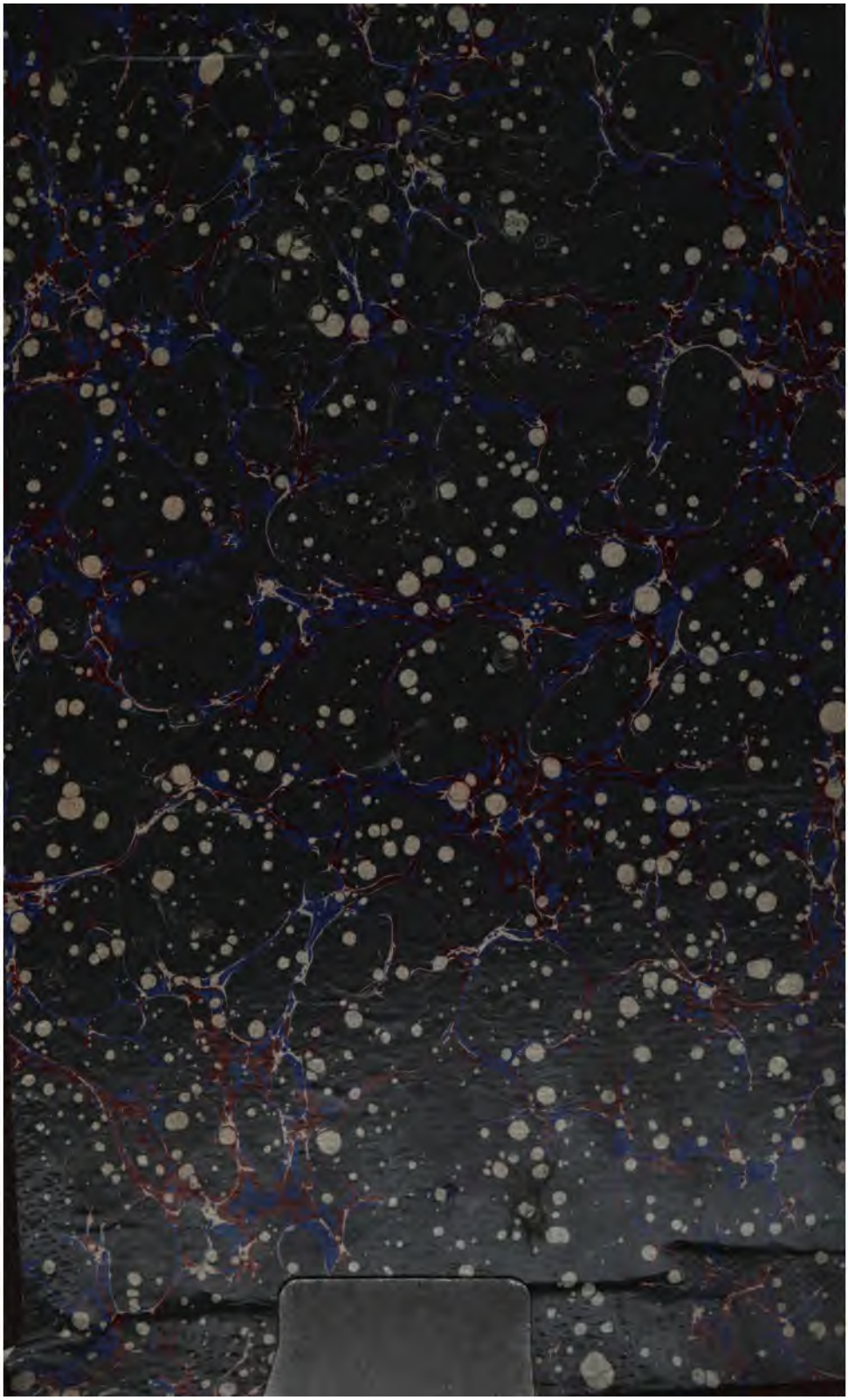

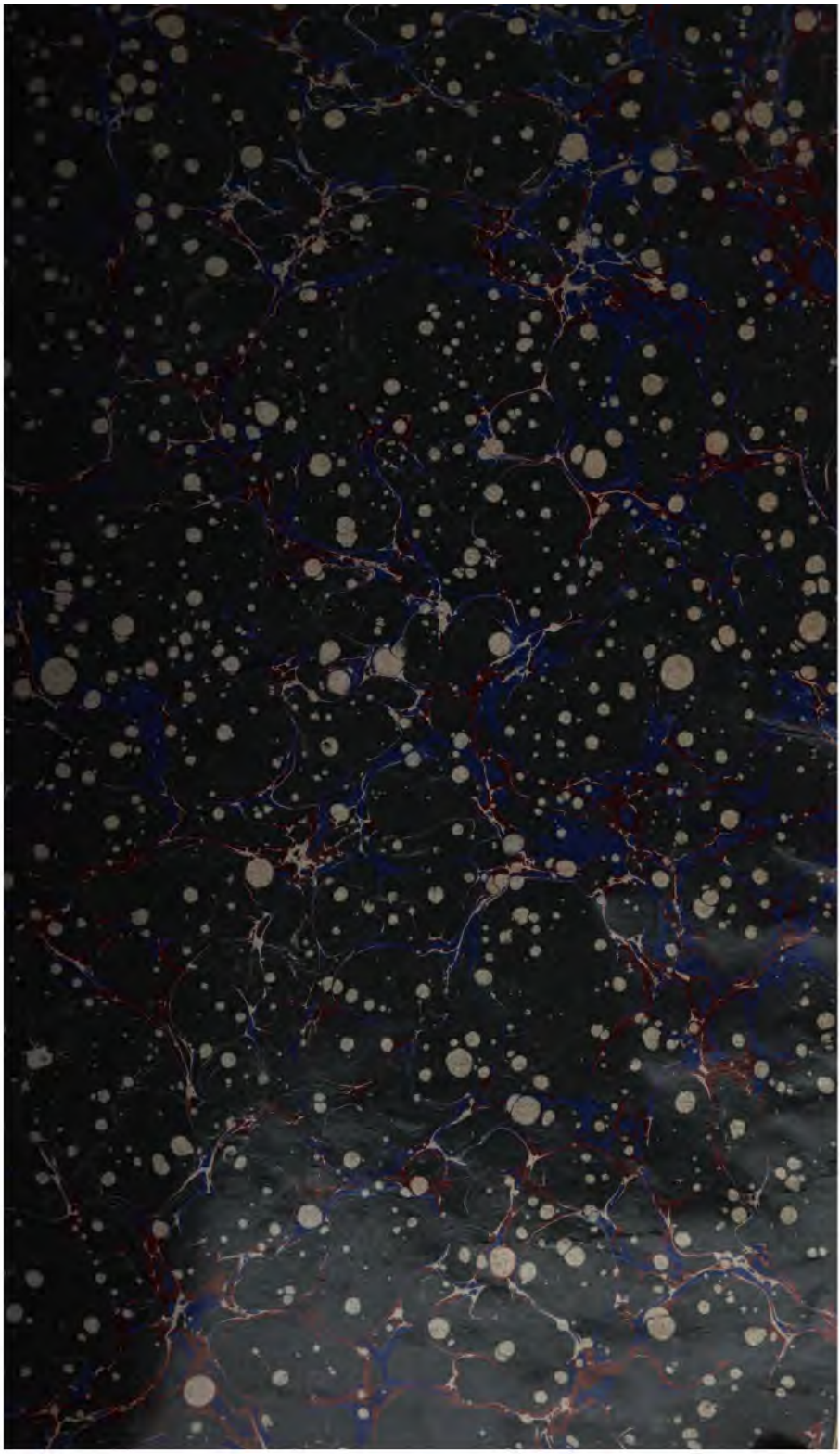

PROCEEDINGS

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HELD AT PHILADELPHIA FOR PROMOTING USEFUL KNOWLEDGE.

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VOL. XL. JANUARY, 1901. No. 165.

Stated Meeting, January 4, 1901.

Vice-President WISTAR in the Chair.

Present, 10 members.

The Librarian laid upon the table the list of donations to the Library, and thanks were ordered therefor.

The decease was announced of the Rt. Hon. Lord Armstrong, at Cragside, Rothbury, England, on December 27, 1900, at the age of 90 years.

Dr. R. W. Shufeldt presented a paper on "The Osteology of the Cuckoos (Coccyges)."

The Judges of the Annual Election for Officers and Councillors, held this day between the hours of two and five in the afternoon, reported that the following-named persons were elected, according to the Laws, Regulations and Ordinances of the Society, to be the officers for the ensuing year:

President.

Frederick Fraley.

Vice-Presidents.

Coleman Sellers, Isaac J. Wistar, George F. Barker.

Secretaries.

I. Minis Hays, Samuel P. Sadtler, Edwin G. Conklin, Arthur W. Goodspeed.

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Treasurer.

Horace Jayne.

Curators.

J. Cheston Morris, Benjamin Smith Lyman, Henry Pettit.

Councillors to serve for three years.

Richard Wood, Henry Carey Baird, Samuel G. Dixon, Joseph G. Rosengarten.

The Society was adjourned by the presiding officer.

THE OSTEOLOGY OF THE CUCKOOS.

[COCCYGES.]

(Plates I and II.)

BY DR. R. W. SHUFELDT.

(*Read January 4, 1901.*)

INTRODUCTION.

My first paper evidencing any special interest in the structure of the Cuckoos was published in *The Ibis*, of London, July 1, 1885 (pp. 286–288), and was entitled "On the Coloration in Life of the Naked Skin-tracts on the Head of Geococcyx californianus," being illustrated with a fine colored figure of the head of the Californian Road-runner, natural size. In this paper the osteology of *Geococcyx* was not touched upon, it merely calling attention for the first time in science to the brilliant scarlet coloration of the naked areas on the back of the head of the bird in question. This paper was, however, soon followed by another in January, 1886, in which a complete account of the skeleton of *Geococcyx californianus* was given, illustrated by three plates, devoted to figuring the skull from three or four points of view, and also all the other bones in the osseous system of this species. It was published in *The Journal of Anatomy and Physiology* (London and Edinburgh, Vol. xx, Part II, pp. 244–266, Pls. VII–IX). As in the case of a few others, this memoir is referred to again below, and is indeed, without its figures, substantially reproduced in the present work, after having been thoroughly revised (and augmented slightly) by myself. Al-

though the figures to this memoir were not, as I say, here reproduced, I have, nevertheless, devoted one of my present plates to the bones of *Geococcyx*, giving four of the skull, one of which has never been published before; a ventral view of the pelvis published for the first time; and pelvic limb-bones of a subadult individual to illustrate remarks in the text. These bones are given for the purposes of comparison and reference.

Again in the same journal last quoted I printed in October, 1886, a brief "Osteological Note upon the Young of Geococcyx californianus (Lond. Vol. i, Pt. i, pp. 101–102), in which certain points of interest referable to the tibio-tarsus were dwelt upon.

A very general account of the entire structure of this species I published still later on in the *Proceedings of the Zoölogical Society of London* (Apr. 1, 1887. Pt. iv, pp. 466–491, Pls. XLII–XLV, 2 wcc. in text)—that is, apart from a treatment of the skeleton, as that had already been published, as stated above. The figures to this memoir had been submitted the size of life, but were subsequently reduced, a fact that was noted, or rather record made of in *The Auk* later on (*Geococcyx californianus*—A correction, Vol. iv, No. 3, July, 1887, pp. 254, 255). After this date I referred to the anatomy of the *Coccyges* in various places and in different publications, but gave no extensive work devoted exclusively to a study of their osteology as a whole.

In the present memoir I have brought together all the material illustrating the osteology of the Cuckoos at my command, and have described and compared it. I am indebted to Mr. Lucas for the loan of some of this material from the collections of the United States National Museum, where, unfortunately, they are very poor in Cuckoo skeletons. The balance of what I have, has been either collected by myself or for me by others.

Representatives of the Suborder COCCYGES are found in many parts of the world, and Cuckoos present us, in the forms already known to science, with a list of some one hundred and sixty or more species, exhibiting great variation in structure, size, coloration and, indeed, general morphology. Their peculiar habits of nidification and other eccentricities that characterize them are known to ornithologists and ornithotomists alike, and need not be reviewed here in a work upon their osteology. Some Cuckoos, the "Tree Cuckoos" so-called, are arboreal types, rarely alighting upon the ground,

while others, such as our Californian "Road Runner," are naturally terrestrial habitues, and only occasionally alight in the larger trees. Both Africa and Madagascar contain wonderfully interesting Cuckoos, and other birds so closely related, that by some systematists they have been associated with them.

Our own United States avifauna offers a number of some very interesting species of the *Cuculidæ*, and these will be osteologically treated in this memoir, and it is hoped that such characters as their skeletons present may be eventually useful when our material in the museums admits of a more extended morphological and taxonomial study of the entire family.

In lower California and Texas we have *Crotaphaga sulcirostris*, and its ally *C. ani* in southern Florida. I have, thanks to Mr. Lucas, of the U. S. National Museum, some material illustrating the skeletons of both of these types. Through the southern parts of southwestern United States we also find *Geococcyx californianus*, —a large and interesting species of Ground Cuckoo. This species, as stated above in my INTRODUCTION, I chose several years ago, to present a paper upon its osteology, and it was published with three Plates in the *Journal of Anatomy* of London. Finally, we have several species of those typically American Cuckoos of the subfamily *Coccyginæ*. They include the true Tree-cuckoos of the genus *Coccygus*, and I have a number of skeletons of them, illustrating both adult and nestling forms. For one good skeleton of an adult, I am indebted to Dr. W. S. Strode, of Bernadotte, and to my son for an alcoholic nestling of *Coccygus americanus*.

As a group, Huxley considered that the *Coccygomorphæ* occupied the central position of his Desmognathous division, and in a subdivision of them (*b*) he included the *Musophagidæ*, *Cuculidæ*, *Bucconidæ*, *Rhamphastidæ*, *Capitonidæ*, and *Galbulidæ*, adding upon another page that "Among the *Cuculidæ*, *Cuculus canorus* is devoid of basipterygoids; the palatines are rounded off posterio-externally; the internasal septum is well ossified and unites with the maxillo-palatines."

"In *Geococcyx* the principle of construction is quite the same; but the postero-external angles of the palatines are distinctly indicated, and the beak is produced into an elongated triangular form. A slight oblique ridge marks off the flat surface of the maxillary process of the palatine from the excavated body of the bone." (P. Z. S., 1867, pp. 444 and 466.)

Professor Max Fürbringer makes a suborder Coccygiformes, a division of his Order CORACORNITHES, and in it divides the genus *Coccyges* into the two families *Musophagidæ* and *Cuculidæ*, the latter containing all the Cuckoos.[1]

As our knowledge of the morphology of the group now under consideration becomes more intimate, the general tendency is to withdraw from its many species, indeed sometimes an entire family or more, of birds that in former times were considered to be quite typically coccygine in character. It was Sclater who finally removed the *Trogones* from the group, and in due time, I am confident the *Coccyges* will be fully as well circumscribed as either the *Pici* or the *Psittaci*.

Several years ago, Coues still adhered to the old "polymorphic group," the Order PICARIÆ, and divided it into three groups, viz.: the *Cypseliformes*, the *Cuculiformes*, and the *Piciformes*.[2] Of the

[1] "FÜRBRINGER, MAX, *Untersuchungen zu Morphologie und Systematik der Vögel* (1888), and on page 1553 of this work he says, "Mit den ektamphibolen *Musophagidæ* und den zygodactylen *Cuculidæ* beginnt die Reihe der Baumvögel (Coracornithes s. Dendronithes). Beide sind mit einander ziemlich nahe verwandt und bilden die G. COCCYGES und So. COCCYGIFORMES, welche trotz einzelner specieller und ziemlich hoher Differenzirungen der Cuculidæ im Grossen und Ganzen doch nur eine mittlere Entwickelungshöhe unter den Coracornithes erreicht und von allen Unterordnungen derselben von den Galliformes am wenigsten absteht. Die kleine, enggeschlossene und jetzt auf die aethiopische Region beschränkte Familie der *Musophagidæ* repraesentirt den primitiveren und in der Abnahme begriffenen Typus; in tertiärer Zeit war sie vielleicht auch über Europa und noch weiter ausgedehnt (Necrornis?) Die nahezu kosmopolitischen *Cuculidæ* sind weit umfangreicher und mannigfaltiger ausgebildet und in der Hauptsache höher differenzirt; von ihren Unterfamilien dürften wohl im Grossen und Ganzen die Phoenicophainæ den tiefsten, die Crotophaginæ den höchsten Platz einnehmen. Ihre paleontologische Kenntniss ist allzu mangelhaft, um systematische Aufklärungen zu gelben.

"In einer nur mässigen Entfurnung von den *Cuculidæ* scheint die kleine Familie der neotropischen *Bucconidæ* zu stehen; der Mangel eigener Beobachtungen und die bisherige Unvollständigkeit in der morphologischen Untersuchung irgend eines Vertreters derselben machen mir eine sichere Entscheidung hinsichlich ihrer systematischen Stellung vor der vermuthlich näher verwandt dieselben kehren zugleich ihr Gesicht den Pici zu, ohne aber intimere Relationen zu ihnen zu besitzen. Vorausgesetzt, dass die bisherigen Angaben über die *Bucconidæ* richtig sind, bin ich geneigt, beide Familien zu der G. GALBULÆ zu verbinden und diese als eine intermediäre Abtheilung zwischen die Coccygiformes (*Cuculidæ*) und Pico-Passeriformes (*Pici*) zu stellen."

[2] COUES, E. *Key to North American Birds*, rev. ed., 1884, p. 446.

second-named he said that they comprehended the great bulk of the Order; "in all, about fifteen families, rather more than less. They are only readily limited by exclusion of the characters of the preceding and following groups. The sternum is usually notched behind; the syringeal muscles are two pairs at most. The feet are *generally* short; the disposition of the toes varies remarkably. In the *Coliidæ*, or colies, of Africa, all the toes are turned forward. In the *Trogonidæ*, the second toe is turned backward, so the birds are zygodactyle, but in a different way from all others. Families with the feet permanently zygodactyle in the ordinary way by reversion of the fourth, or partially so, the outer toe being versatile, are—the *Cuculidæ*, or Cuckoos, with their near relatives the *Indicatoridæ* or Guide-birds of Africa; the *Rhamphastidæ*, or Toucans, confined to tropical America and distinguished by their enormous vaulted bill; the *Musophagidæ*, Plaintain-Eaters or Touracos, of Africa; the *Bucconidæ* and *Capitonidæ*, or fissirostral and scansorial Barbets of the New and chiefly of the Old World respectively; and the *Galbulidæ*, or Jacamars, of America. (The *Cuculidæ* and *Musophagidæ* are by Garrod placed together with Gallinaceous birds.) In the remaining groups, the toes have the ordinary position, but sometimes offer unusual characters in other respects. Thus in the *Alcedinidæ* (Kingfishers), and *Momotidæ* (Motmots or Sawbills), the middle and outer toes are perfectly coherent for a great distance, constituting the *syngenesious*, *syndactyle* or *anisodactyle* foot. The *Bucerotidæ*, or Hornbills, of the Old World, characterized by an immense corneous process on the bill, are relatives of the Kingfishers; so are the *Todidæ*, a group of small, brightly-colored birds of Mexico and the West Indies. Other forms, all Old World, are the *Meropidæ* or bee-eaters, the *Upupidæ* or Hoopoes, and the *Coraciidæ* or Rollers, with their allies the *Leptosomatidæ*, of Madagascar."

Garrod examined a good many Cuculine birds, and he divided the *Cuculidæ* into the *Centropodinæ* to contain the Ground Cuckoos, and the *Cuculinæ*, or True Cuckoos.[1] Several years later I examined the structure of *Geococcyx californianus*, and in the opinion I

[1] GARROD, A. H. *Collected Scientific Papers*, 1881, p. 220. This author found the *Cuculidæ* to possess the ambiens muscle, two carotids, a nude oil-gland and cæca. The *Centropodinæ* have a formula AB. XY and the *Cuculinæ*, A. XY.

then arrived at it appeared clear to me that Garrod's classification of the *Cuculidæ* was well supported."[1]

Nitzsch did something with the classification of the Cuckoos, using their various patterns in pterylography, but the work was only partial and in the main not quite satisfactory.[2]

In 1873 (P. Z. S., p. 578) Mr. Sharpe, of the British Museum, again attacked them, selecting for his labors the cuculine birds of the Ethiopian Region. He made two subfamilies of the forms there represented and examined, viz: (1) *Cuculinæ*, containing *Cuculus* and *Coccystes*, and (2) *Phœnicophainæ*, in which he placed *Phœnicophaës*, *Centropus*, *Coua* and others.

About twelve years later another important paper on the *Cuculidæ* appeared, being a contribution by Mr. F. E. Beddard,[3] and in it he agrees in the main with Sharpe, but makes some few but apparently justifiable changes. His opinions are deduced from a study of the muscles of the thigh, the syrinx and the pterylosis of the *Cuculidæ*. He was fortunate in being enabled to study a very large series of species representing some thirteen genera, and upon this material he divides the Family CUCULIDÆ into three Subfamilies, the *Cuculinæ*, in which our *Coccyzus* is found in group (*b*); the *Phœnicophainæ*, containing only Old World forms; and the *Centropodinæ*,

[1] SHUFELDT, R. W. *Contributions to the Anatomy of Geococcyx californianus. Proc. Zoöl. Soc. of London*, 1886, pp. 466–491, Pls. XLII–XLV. It was shown here that our United States *Cuculidæ* properly belonged to three subfamilies, the *Crotophaginæ*, or Anis, the *Centropodinæ*, or Ground Cuckoos, and the *Cuculinæ*, or True Cuckoos. Besides the paper on the Osteology of *Geococcyx*, published in the *Journal of Anatomy of London*, and referred to above, the writer has also produced two other minor contributions to the morphology of this bird—viz., one in the *Ibis* with a colored plate, showing the colored skin-tracts around the eye and back of the head (Lond., 1885, pp. 286–288, Pl. VII): and the other in the *Journal of Anatomy of London* entitled, "Osteological note upon the young of *Geococcyx californianus*" (Vol. xxi, pp. 101, 102, Figs. 1 and 2). The last-named will to some extent be incorporated in the present memoir, and both have already been cited in the Introduction above.

[2] Pterylography, English edition, p. 91.

[3] BEDDARD, F. E. *On the Structural Characters and Classification of the Cuckoos*. P. Z. S., Lond., 1885, pp. 168–187, wcc. in text. In this paper the writer points out an error formerly made by Owen (OWEN, R., Comp. Anat. of Verts., Vol. ii, p. 177), and says: "The *gall-bladder* is stated by Owen to be wanting in almost all the *Cuculidæ*. This statement is by no means correct; indeed the gall-bladder appears to be very generally present, and those cases where it is absent are the exceptions."

where we find *Geococcyx*, *Crotophaga* and *Guira* all associated in another group *b*.

To this last arrangement I very much demur, and doubt that the retention of *Geococcyx* and *Crotaphaga* in the same subfamily at all expresses the natural affinities of these forms within the family. It will be seen later that they are very distinct types of Cuckoos, in so far as they are osteologically organized. As I have already stated elsewhere, I believe the *Crotophaginæ* constitutes a distinct subfamily, and the summation of the entire morphology and a knowledge of their especial habits will go far towards supporting this arrangement.

Osteology of Geococcyx.

Of the Skull.—In *Geococcyx* we find the osseous superior mandible with a gently curved and rounded culmen, the curve increasing very modestly as it approaches the apex. This part of the skull has a broad base, being both deep and wide in the rhinal region, while on all aspects it tapers gradually to the slightly decurved tip. Its buccal surface is flat, with cultrate edges somewhat raised above the general plane behind. Posteriorly, this face is encroached upon by the palatines and maxillo-palatines. Turning to the lateral surfaces of this mandible (Pl. I, Fig. 1), we find them for the most part to be slightly convex throughout their extent; the only exception to this being seen in the depressions which are found, one over each of the scale-like projections that close the hinder two-thirds of either nostril.

These last-mentioned openings are of a subelliptical outline, placed longitudinally nearer to the edge of the beak than its culmen and just posterior to its middle. They do not directly communicate with each other, but are external apertures, in this bird, of osseous tubes, one on either side, which are produced backwards nearly to the rhinal chamber, being encased in the loose, osseous, spongy mass that almost fills the otherwise hollow superior mandible of *Geococcyx*.

In the skull freshly prepared, and before it dries, the cranio-facial hinge enjoys considerable mobility, and its position is clearly indicated by a transverse track. Mesially, this region is depressed, and may show the last sutural traces of the nasal processes of the premaxillary therein. Each nasal bone has been so completely met by the various surrounding elements that, save its hinder margin,

its boundaries are hard to define in the adult bird (Pl. I, Fig. 1). This is not the case, however, in the skull of a nestling *Geococcyx* at my hand, where the bone is easily studied. Its premaxillary process is rather long and very slender, while its two remaining projections are broad. Near its middle it is perforated by a small foramen, which we find persists throughout life and seems to correspond to a similar minute aperture found in the same locality in the skulls of certain Kingfishers (*Ceryle*). All three sides of this osseous superior mandible are more or less marked by anastomosing venations, and a few perforating foramina are always seen near its apex.

A lacrymal in *Geococcyx* is an unusually large bone, though a light one, due to its very open cancellous structure within, and its being, perhaps, pneumatic besides. Superiorly, it articulates with the frontal and nasal, principally with the last on the lateral aspect, though it departs from it some time before reaching its lowest point, where a slit-like interval is seen between the two bones. Below, its broad, rounded margin is placed obliquely, its outer and at the same time posterior end resting upon the upper side of the maxillary, while its inner and anterior end being elevated just above the superior surface of the corresponding palatine.

The posterior aspect of the lacrymal is concave from above downward, in conformity with the somewhat globular concavity of the orbit, while anteriorly it is correspondingly convex in the same direction. It lies in front of the broad, quadrilateral ethmoidal wing which overlaps it, the two forming a very complete partition between the orbit and rhinal chamber, the bone under consideration closing the outer third of the space.

The ethmoidal wing, the form of which I have just given, is pierced above, immediately beneath the frontal bone, by two elliptical foramina, the inner one being the larger, and both being vertical. They probably transmit the olfactory nerve and vessels to the rhinal space.

This "pars plana" has, like the lacrymal, also a somewhat cancellous internal structure, the plate being moderately thick. Its lower and outer margins are concave and smoothly rounded off.

The expanded anterior extremity of a maxillary is immovably wedged in between the nasal above and the posterior dentary process of the premaxillary beneath. Its rod-like extension behind forms about the anterior third of the very straight quadrato-jugal

bar. The horizontally expanded end alluded to is quite ample and may be perforated by numerous foramina. Its maxillo-palatine development will be described when speaking of the under side of the skull.

The remainder of the quadrato-jugal bar becomes gradually larger and club-shaped as it nears the quadrate bone, to rather abruptly turn inward as it reaches it, and is inserted in a vertical notch in the usual apophysis of that element, which projects directly outward to meet it (Pl. I, Fig. 2).

With respect to the quadrate, we find that its orbital process is very broad and flat, being at the same time very short. The body of the bone is also broad, while its mastoidal apophysis is twisted in a way common to many other birds, and supports at its summit two articular heads with a distinct valley between them. At the inferior aspect of the mandibular foot there are two condyles for articulation with the lower jaw. The inner and smaller of these is hemi-ellipsoidal in form, with its major axis in the same straight line that constitutes the longitudinal axis of the corresponding pterygoid. If this axis be produced the other way, it is found to be at right angles to the long axis of the other and larger facet of the mandibular foot of the quadrate. Rather a broad notch separates these two condyles from each other.

The quadrate is a thoroughly pneumatic bone, and a large foramen is always found upon its posterior aspect half way between the mastoidal head and the mandibular foot.

Both the sphenotic and mastoid processes are well developed in this bird; they are of about an equal size, the first being directed downward, and the last downward and forward. Between them, and carried well to the rear, is a sharply defined and rather deep crotaphyte fossa. It is separated from a like depression of the opposite side by an interval of one and a half centimetres. These crotaphyte fossæ are fully as well marked in *Geococcyx* as they are in many of the *Laridæ*, and better than they are in some members of that group of birds, better, for instance, than they are in *Larus philadelphia*.

Owing to the great breadth of the frontals, the orbit is completely sheltered above by an arching roof, the outer periphery of which is concave inward and bounded by a sharp edge. This orbital vault usually shows posteriorly a few perforating foramina. The rostrum of the sphenoid is pneumatic and rounded for its entire length

beneath. It barely extends beyond the broad ethmoidal wings in front and ascends but little as it proceeds in that direction. In the nestling it is seen to be sharp-pointed anteriorly and grooved its entire length superiorly.

The inter-orbital septum is a thin partition of bone, which always possesses a considerable quadrilateral vacuity near its centre. This usually merges with the foramen for the exit of the optic nerves (Pl. I, Fig. 1), while the small foramen for the exit of the oculi-motor remains distinct.

As might be expected from what has already been said about the orbit, we find its hinder wall also very broad and generally concave forward. At its usual site a distinct, irregular foramen of some size is found for the exit of the olfactory nerve, and this branch passes forward in the living bird in a shallow channel on the inter-orbital septum beneath the frontal for its entire length, where these two elements are united. It leads to the inner and larger of the two foramina that were described above as occurring over pars plana.

Before leaving this side view of the skull it will be as well to notice the large, luniform sesamoid that occurs in the ligament that passes from the quadrato-jugal to the hinder border of the articular cup of the mandible. This sesamoid is present on both sides and in all the skulls of *Geococcyx* that I have ever had the opportunity of examining.

On the superior view of the skull we are to note the form of the bony laminæ that partially close in the external narial openings from behind; the position of the two small circular foramina beyond the cranio-facial hinge; and this fronto-lacrymal region generally. From this aspect we also see the small foramina that pierce on either side the orbital roofs behind. Mesially, and between these latter, a shallow, longitudinal groove marks the cranial vault. Posterior to this again we find a smooth, globular and ample parietal region. The crotaphyte fossæ may likewise be discerned from this upper aspect and a glimpse obtained of the supra-occipital prominence. Here, too, may also be seen the manner in which the quadrato-jugals articulate with the quadrates.

Viewing the skull of *Geococcyx* from beneath, we find, anteriorly, the broad, flat surface, already spoken of, which forms the lower face of the superior mandible (Pl. I, Fig. 2).

Following this back we come to an elongated median vacuity,

that separates the anterior terminations of the maxillo-palatines. This aperture has irregular, jagged edges, and through it we may see some of the open, spongy bone tissue that partially fills the hinder portion of the core of the superior mandible. At the sides, the posterior processes of the dentary parts of the premaxillary overlap the maxillaries. They are long and triangular, with their apices to the rear.

Returning to the maxillo-palatines, we find them to be, upon this aspect of the skull, two very sizable, elongated, subcylindrical masses, composed of an internal spongy tissue, but encased in an outer covering of an extremely thin layer of compact tissue. They lie parallel to each other and to the median plane, nearly filling the interpalatine space. Anteriorly, they are separated by the vacuity already described, while behind, their free and rounded extremities slightly diverge from each other, they being in contact in the median line for the middle thirds of their lengths (Pl. I, Fig. 2). From their upper sides is developed a mass of open spongy tissue; this is continuous with a similar structure that is found within the superior mandible; it reaches out, on either side, to abut against the inner surfaces of the nasals; it joins the horizontal plates of the maxillaries, and finally supports a median vertical plate of bone that stands just beyond the rhinal chamber proper, this latter space being free from its encroachment, as it is from any development of the ethmoid behind, beyond its lateral wings.

The anterior half of either palatine is quite a broad, flat, horizontal plate, the distal end of which indistinguishably fuses, and is directly continuous with the horizontal portion of the premaxillary. To its inner side also, in this locality, it completely anchyloses with the corresponding maxillo-palatine (Pl. I, Fig. 2). For the most part, however, its inner and outer edges are free, not coming in contact by the inner one with the maxillo-palatine, though it is parallel to it and separated by an extremely narrow interval, while its outer one neither touches the lacrymal nor the maxillary, but occupies a plane inferior to both.

The posterior half of a palatine also lies mainly in the horizontal plane, but its under surface is a concave one, and its upper correspondingly convex. Its outer free edge, directly continuous with the outer edge of the anterior half of the bone, sweeps by a gentle curve round the "postero-external angle" of the palatine to its head. Huxley was in error when he stated (P. Z. S., 1867, p.

444) that these angles in *Geococcyx* "are distinctly indicated." They are rounded, as he so well figures them for *Cuculus canorus*.[1]

The inner free edge of the bone extends from the head to the apex of a small pointed process in front. For nearly its entire length it is parallel to the corresponding edge of the palatine of the opposite side, from which it is separated by an interval of something like a millimetre or rather more. From this edge the surface curves outward and backward, forming the "ascending process" of the palatine. This terminates in another longitudinal straight margin, which is applied to the corresponding one of the opposite palatine, and both unite to form the usual groove at their upper aspects for the rostrum of the sphenoid. These latter opposed edges also extend from the palatine heads, likewise in contact mesially, to a common anterior process. This latter is nearly opposite the anterior end of the rostrum, and from its extremity in front projects a free, needle-like and rudimentary vomer, of some four millimetres in length. It does not come in contact with the maxillo-palatines, but lies above the interval formed by their slightly diverging posterior extremities, and is freely articulated with the palatines at the points from which it springs, and in the manner described. This diminutive vomer is equally well developed in both my specimens of *Geococcyx*.

Careful search was made in all of my specimens for an *ossiculum lacrymo-palatinum* (*os uncinatum*), but failed to reveal the presence of any such ossicle. This diminutive bone was first described by Brandt, and, as is well known, occupies at least two positions in the skull. In certain Albatrosses (*Diomedea brachyura*) it exists as a delicate styliform bar connecting the descending limb of the lacrymal bone with the upper surface of the corresponding palatine. Other birds have it attached to the infero-external angle of the lacrymal, where it may project freely backward, or lie along the upper surface of the maxillary bar beneath it. Its position in the Parrots is described in my memoir on the osteology of *Conurus*.

According to Forbes, "it also occurs in forms so different from these [Albatrosses] as the Musophagidæ, many Cuculidæ, *Chunga*

[1] In this connection compare what I have quoted, in an early paragraph of this memoir, from Professor Huxley with a footnote which appeared in my "Osteology of Geococcyx" (*Journ. of Anat.*, London, p. 247), cited above. It must be that the skull of *Geococcyx* which Professor Huxley examined was either an imperfect or broken one.

and *Cariama*, as well as in some Laridæ and Alcidæ, so that its presence is obviously of no particular taxonomic value." (*Coll. Scientif. Mem.*, p. 415.)

A pterygoid is a nearly straight and slender bone, and shows not the slightest evidence of the development on its shaft of an apophysis, and indeed there is no necessity for such, as the basipterygoidal processes are entirely absent in this bird; and the pterygoids when *in situ* occupy a lower plane than the basitemporal region, as well as being at some distance in front of it.

These bones articulate with each other anteriorly and with the opposed palatines; from this point they diverge at an angle of about 85°, each to meet the usual facet upon the corresponding quadrate at the base of the inner and smaller condyle on that bone.

The basi-temporal region is elevated above the prominent and raised boundaries of the auricular apertures; it is narrow and smooth and lies for the most part in the horizontal plane. In front, it presents for our examination a thin tip of bone, arching over the common aperture of the Eustachian tubes.

Beyond this it contracts to form the sphenoidal rostrum, a considerable portion of which is unoccupied before we reach the pterygoidal heads. This allows these bones not a little backward play in the recent specimen, an action which is quite possible from the more than ordinary mobility enjoyed on the part of the craniofacial hinge.

Either external auricular couch is a capacious fossa, well defined by a raised and bounding thin wall of bone, with its free edge curled in all round. At the base of either of these fossæ we see strong osseous trabeculæ, converging to a point near the centre to support the double concave facet for the mastoidal head of the quadrate. These stand between the Eustachian entrance and the passage to the middle ear.

If the plane of the basis cranii be produced posteriorly, and the plane of the occiput and foramen magnum extended to meet it, we find the latter makes an angle with the first-mentioned plane of about 48°, while the long axis of the fairly well-developed supra-occipital prominence would be perpendicular to it. In form the foramen magnum is broadly cordate with its apex above; the occipital condyle at its lower margin is small, sessile and hemispherical in outline, being so placed as to encroach upon the foraminal periphery for about one-third of the condylar arc.

Points of interest within the brain-case are seen in the presence of a strongly marked longitudinal sinus and the unusual thickness of the walls of the sella turcica; its fossa, though deep, being quite small, while at its base we find a double entrance for the carotids.

As a whole the skull of *Geococcyx* is a delicate and a very light structure for its size, air gaining thorough access to most of its parts.

The mandible (Pl. I, Figs. 1 and 3), seen from superior aspect, has the typical V-shaped form, with an extensive symphysis, which is scooped out longitudinally above. Either ramus is not deep in the vertical direction, while its upper and lower margins are prominent and rounded, the former, however, becoming sharp as it approaches the symphysis, which condition is sustained to the mandibular apex.

The ramal vacuity is large and occupies its most usual site; in outline it is an elongated ellipse, but its anterior third is encroached upon by a thin plate developed on the part of the dentary element.

An articular end is considerably concave above and presents two facets for the condyles of the quadrate; its inturned process is much tipped up, while the usual pneumatic foramen is seen near its apex. Below, its convexity conforms with the convexity of the articular excavation at its upper side, and its angle behind is obliquely truncate from above downward in the forward direction.

Beyond an articular end on the superior ramal border, we find, on either side, the coronoid process but feebly developed and single.

When the osseous mandible is articulated *in situ* with the remainder of the skull its tip does not extend quite so far forward as does the apex of the superior osseous beak, a condition present in the skulls of most *Coracomorphæ* and other groups.

In the hyoidean apparatus we find fully the anterior two-thirds of the glosso-hyal represented by a thin strip of cartilage, while behind, where it ossifies in front, the usual median foramen is seen, having an elliptical outline. Posterior to this, on either side, the strongly marked cerato-hyals project outward and backward.

First and second basi-branchials do not anchylose with each other, the former being short and thick, the latter about half as long again and tipped off behind with cartilage.

The elements of the thyro-hyals are long and slender; they like-

wise terminate in cartilaginous tips and curve up behind the skull in the manner most usual among birds.

There are about twelve osseous sclerotal platelets in the circlet found in either eyeball. They present us with nothing worthy of especial remark, seeming to possess their most usual ornithic characters.

It may be as well to add here a few words describing the ossifications of the trachea, and we find for the entire length of this sub-cylindrical tube the osseous rings which compose it fail to meet in the longitudinal median line posteriorly.

The interval thus formed, which is not very great, is occupied by a thin membrane which is continuous with the internal tympaniform membrane of the lower larynx. As to shape, the trachea diminishes in calibre gradually from above downward, and nowhere in its continuity does it present any enlargements or dilatations.

This does not apply exactly to the bronchial bifurcations, for each one of them shows a disposition to swell just before arriving at the contracted parts of these tubes, where they impinge upon the lung tissue.

We may reckon either of these bifurcations as being partially surrounded by thirteen semirings. Of course in this bird, as I say, the entire trachea may be regarded as having only semirings, but had the usual number of these united behind there would still have remained the thirteen semirings to each bronchial tube. An osseous pessulus is not present in *Geococcyx*, and the internal tympaniform membrane is quite extensive. There does not even seem to be any thickening of this membrane in our subject where this bony little bridge is located in those birds where it exists. (For figures of the trachea of *Geococcyx* see my memoir in the P. Z. S. cited above.)

Of the Remainder of the Axial Skeleton—The Vertebral Column.—This column presents us with eighteen movable vertebræ before we arrive at the consolidated pelvic sacrum. This latter contains eleven more segments, thoroughly united together and firmly joined to the iliac bones. Finally, we find five vertebræ and a large pygostyle in the skeleton of the tail of *Geococcyx*.

In the cervical region we pass twelve vertebræ before we come to the first one of the series that bears a pair of free ribs, the thirteenth and fourteenth both possessing these appendages, and in both they are well developed, though not reaching the sternum, through the intervention of costal ribs. The pair on the fourteenth vertebra

has the epipleural processes fully as large as they are in the dorsal series; they are absent entirely, however, on the first pair of free ribs.

Returning to the atlas we find this segment rather delicately constructed, though in form it is quite like what we find in other groups of birds, the *Passeres* for instance. Its neural arch is narrow antero-posteriorly, though the canal is capacious. A perforation is seen at the base of the articular cup for the occipital condyle, which cuts through the superior margin of this little concavity. The centrum is small and does not develop anything that might be called an hypapophysis. On the axis vertebra we note the presence of a low, tuberous, neural spine, occupying the entire central portion of the arch, while posteriorly on the under side of the centrum a feebly pronounced hypapophysis is seen. The odontoid apophysis is small and short as compared with other features of this vertebra, a fact no doubt due to the lack of depth in the atlas. At either side of the centrum we observe a delicate and vertical spicula of bone which completely arches over the vertebral vessels, constituting the last remnants of the lateral canal at this extremity of the column. This condition is often met with among the *Anatidæ* in the axis vertebra of those birds.

The postzygapophyses are directed backward and outward, and are very powerfully developed, more so than in any of the first nine or ten vertebræ of this portion of the column. The facets they bear for articulation with the extremities of the prezygapophyses of the third segment are at their under side about the middle. On the third and fourth vertebræ we also find a low neural spine placed at the centre of either bone, while the hypapophysis is becoming reduced in these segments, to disappear entirely in the fifth vertebra. These vertebræ, as in so many of the class, have their zygapophysial processes joined by a spanning lamina of bone, which in either case and on either side is pierced near its middle by a small elliptical foramen of the greater size in the fourth vertebra.

The lateral canals occupy rather more than the anterior halves of the sides of the centra, and the processes that project from the under aspects of their free margins behind are short, and each is separated by a considerable interval from its fellow of the opposite side. This great inferior width of the cervical vertebra is a characteristic feature of these segments in *Geococcyx*, and is well sustained throughout the series until we come to the free rib-bearing

ones, when a gradual contraction takes place as we pass into the dorsal region. But even here the segments are comparatively broader in their transverse diameters than we often find them.

In the fifth vertebra the neural spine is placed further forward on the bone, but is very small; it is absent in the sixth, or only faintly indicated, and it does not appear in the series again until we find it as a pronounced crest on the fifteenth segment. Sometimes, however, a low, tuberous elevation marks its site in the few ultimate cervicals.

Prezygapophyses in the fifth vertebra stand almost directly outward, while the postzygapophyses very prominently point to the rear. Little modification takes place in the former of these processes as we examine the succeeding vertebræ, their general direction remaining about the same, but the articular facets they bear face more and more toward the median plane as we proceed backward. With the postzygapophyses, however, the case is otherwise, for as we descend the cervical series we find these become gradually shorter and stouter with a wider divergence, while their facets, from facing downward and outward, come to look almost directly downward.

We find strongly marked metapophyses surmounting the bases of the postzygapophyses in the sixth to the ninth cervical vertebræ inclusive; after that they disappear, and are but feebly reproduced in the dorsals, where they occur on the superior aspects of the ends of the transverse processes.

On the fifth cervical vertebra the lateral canal is at its forward part, appropriating about the anterior moiety of the entire centrum. Its outer wall may show a slight perforation, while the parapophyses which project from it behind are on either side a short and needle-like spine. As we pass down the series this perforation becomes larger and larger, until in the tenth vertebra it has broken through the hinder free margin of the lateral canal and disappeared, leaving in the segment only a shorter passage and a deep concave notch indicating its site. *Pari passu* with this change, the parapophyses and pleurapophyses pass through the usual evolution in that direction, to result in the perfect and free pair of ribs found in the thirteenth vertebra. Faint beginnings of a carotid canal are also seen in the fifth vertebra, in the presence of a shallow excavation at the anterior end of the under side of the segment. This becomes better and better marked to include the tenth vertebra,

where this canal is moderately well protected by lateral walls, but in none of the series does it become a closed passage as in some other birds. In the eleventh vertebra its place is taken by a strong, single and median hypapophysis.

This last becomes faintly tricornate in the twelfth vertebra, markedly so in the next segment; the three prongs springing from a common pedicle in the fourteenth, which pedicle is lengthened in the fifteenth; still larger but without terminal prongs in the sixteenth vertebra, to be entirely absent in the succeeding segment and the rest of the column.

In the atlas the neural canal is capacious and transversely elliptical. From this vertebra it gradually changes its form and contracts in calibre, until in the fifth vertebra we find it nearly cylindrical in shape and much reduced in capacity.

Passing down the series it gradually changes for a second time, so that in the eleventh vertebra it is again found to be large and transversely elliptical. This form it retains through the dorsal series, though once more reduced in calibre.

In the tail vertebræ it is at first triangular with apex above, to become a vertical slit as it enters the pygostyle.

The fifteenth, sixteenth, seventeenth and eighteenth vertebræ of the column in *Geococcyx* support ribs that meet to articulate with costal ribs below.

These ribs are broad above, but become more and more rod-like as they near their hæmapophysial articulations. The first three pair of the series bear large epipleural processes, which are always anchylosed to the rib upon which they appear. These three also have costal ribs connecting them with the sternum; this I believe to be as small a number of the latter present in any living bird—*i.e.*, only three hæmapophyses articulating with either costal border of the sternum. The last pair of ribs, or those coming from the eighteenth vertebræ, never have epipleural processes, and their costal ribs do not reach the sternum.

With respect to the four vertebræ that bear the ribs, we find that they present all the characters of the dorsals as found among Aves generally. The neural spines are lofty and quadrilateral in outline, each having its superior rim capped off with a vertically flattened tablet of bone. The diapophyses are rather broad, and project directly outward from the sides of the vertebræ, having the ribs articulating with them and the centra in the usual way. Very

close interlocking is evidenced among these four dorsal segments, and the post- and prezygapophyses are no longer than is necessary to afford the proper amount of surface for their respective articular facets. Anteriorly, these face upward and inward, precisely the reverse being the case with those found on the postzygapophyses.

So far as we have examined the vertebral column, the articulation which obtains among the centra is upon the *heterocœlous* plan—*i.e*, the anterior facet is concave from side to side, convex from above downward, precisely the reverse condition being present in the posterior facet. All these vertebræ, as well as both kinds of ribs, are eminently pneumatic, groups of foramina occurring at the usual sites in these bones.

The Pelvis (Pl. I, Fig. 4).—From its singularly unique form the pelvis of *Geococcyx* has attracted the attention of a number of anatomists. Owen speaks of the ilium as forming behind "a prominent ridge in most birds, which generally overhangs the outer surface; in *Geococcyx* to a remarkable extent, like a wide penthouse, producing a deep concavity in the outer and back part of the ilium, where it coalesces with the ischium." [1]

Marsh, in his classical work upon the *Odontornithes*, again calls attention to the same thing, and points out other particulars in connection with it, making admirable comparisons with the pelves of *Reptilia, Tinamus* and other forms.[2]

Strange to relate, the only other living American bird, so far as I have examined, that possesses a pelvis anything like the one we find in *Geococcyx* is the common Sora Rail (*Porzana carolina*).

This bird not only has either ilium forming the peculiar outward-curling crest behind, but has also the propubis well marked and identically the same style assumed by the anterior portions of the ilium, *i.e.*, a deeply concave inner margin, with the sacral crista mounting above it and not coming in contact with the same.

Viewing the pelvis of *Geococcyx* from above, we are to notice the condition just alluded to as well as the raised anterior emargina-

[1] *Anat. of Verts.*, Vol. ii. p. 34, London, 1866.

[2] Marsh, O. C., *Odontornithes*, pp. 70–73, Figs. 16–20, Washington Government Printing Office, 1880. There certainly can be nothing that advances our knowledge of the exact origin of birds more certainly than the constant comparison of recent forms with the material palæontology has thus far been enabled to supply us—not a great deal as yet. Prof. Marsh never seemed to allow such an opportunity to escape him.

tions of these ilia, with the processes that project from their middle points. As already hinted, the ilio-neural canals are here open grooves, and the neural crest of the sacrum stands between them as a lofty dividing wall, with much thickened superior border. This latter is distinctly marked for the entire length of the sacrum, otherwise the individualization of the vertebræ composing this part of the bone is not very distinct, as few foramina are to be found between their diapophyses until we reach the last one, where regularly occurs a large pair, throwing the ultimate urosacral into bold relief.

Upon the lateral aspect of this pelvis, we not only gain a better view of the largely developed propubis and the strangely formed hinder portion of the ilium, but we are also enabled to get a glimpse of the rather small subcircular ischiac foramen, with the reniform antitrochanter in front of it. This latter faces almost directly forward and only slightly downward, and less so outward. Beyond this again is the acetabulum, with the circular perforation at its base, the postero-superior arc of which merges with the periphery of the outer cotyloid ring at the base of the antitrochanter, while directly opposite this point the arces of these two circles are far apart, and an excavation occupies the intervening space. This grows less, of course, as we proceed either way toward the base of the antitrochanter, where, as I have said, the inner and outer rings are tangent to each other.

The elliptical obturator foramen occupies its usual position, and so close together are the postpubis and ischium that an exceedingly narrow strait leads from this vacuity into the obturator space, a long narrow interval between the last two mentioned bones. At the centre of the triangular area among these three apertures at the side of this pelvis, is found a group of small pnuematic foramina which assist in admitting the air into the substance of this light and thoroughly aerated bone.

The Caudal Vertebræ and Pygostyle.—As already stated above, the caudal vertebræ are five in number (Plate I, Fig. 4). They are chiefly noted for their high and prominent neural spines, the two loftiest being seen in the third and fourth vertebræ. The diapophyses grow longer and more spreading as we proceed in the direction of the pygostle, the last segment possessing them longer than any of the others. We find in the third caudal vertebra a small anchylosed chevron bone, which slightly overlaps the bone in front of it.

This apophysis is very strongly developed in the last two vertebræ, where it is also anchylosed to the centra, is bifid, and hooks well forward to overlap the preceding centrum in either case. Each one of these bones is pierced by pnuematic foramina in a number of places, as is also the terminal coccygeal vomer.

This latter bone has an oblong irregular figure, with its posterior margin considerably thickened, the others being cultrate. The neural canal is continued into it for some little distance, its passage being denoted on the sides of the bone by a longitudinal smooth elevation, which gradually tapers away to the postero-superior angle.

Of the Sternum and Pectoral Arch.—The sternum of *Geococcyx* is a thoroughly pnuematic bone, but air does not gain access to any of the shoulder-girdle elements.

In the case of the former, foramina are chiefly found in the concavities among the hæmapophysial facets on the costal borders. A few scattered ones may be seen in the median line upon the dorsal surface. The number of these latter vary in different specimens.

The "Road Runner" has a two-notched sternum, which gives rise to a pair of flaring xiphoidal processes on either side. Its carina is fairly well developed and moderately deep only. It extends the entire length of the bone, and is marked upon the upper side of its projecting carinal angle by a roughened facet for articulation with the hypocleidium of the furculum.

Osseous welts are raised upon its sides to facilitate muscular attachment, and these, in some specimens, extend on to the ventral aspect of the body. The inferior border of the keel is somewhat thickened.

In front of the sternum a peg-like manubrium projects out, the lower margin of which is longitudinally marked by a sharpened crest. Below this, the perpendicular anterior border of the keel is vertically concave, and this inferior manubrial crest is carried into the excavation as a median raised line.

Either costal border is very short, having but three facets upon it, and these are usually close together. In front of them, on either side, a prominent costal process is reared, constituting one of the most striking features in this part of the skeleton of *Geococcyx*.

The thoracic aspect of the sternum is very much concaved, the ventral side being correspondingly convex. Here on this latter we notice well-marked muscular lines, one on either side, commencing

at the outer termination of a coracoidal groove, and running backward to a point about opposite the middle of the keel.

The coracoidal grooves do not meet at the manubrial base in the median line, and each one is characterized as being a deep transverse notch, with upper and lower lips of projecting bone and extending laterally only so far as the inner or anterior limit of the base of the corresponding costal process. My former memoir in the *Journal of Anatomy* gives figures of the sternum of *Geococcyx*. With respect to the pectoral arch, I find a coracoid to be, comparatively speaking, an unusually long bone; its sternal or lower border extends beyond the facet proper, in order to fit into the coracoidal groove of the sternum. This end of the coracoid is not as much expanded as we find it in some birds, but, on the other hand, like many of the Class, its outer angle is produced and bent upward as a projecting process.

The shaft is long and cylindrical, being marked down its posterior and lateral aspects by muscular lines.

At the superior, or really anterior extremity of this bone we find several noteworthy and interesting characters. Its scapular process is very long, and compressed from side to side. This apophysis reaches forward, and by its slightly dilated extremity articulates with a vertically concave notch in the lower part of the head of the corresponding clavicle.

Another meeting between these two bones takes place above, and this is effected by the summit of the coracoid curving inward toward the median plane, to articulate with a considerable facet found at the highest point of the clavicular head.

These two articulations between the furculum and the coracoid completely close the tendinal canal, even without the assistance of the scapular behind, though this latter bone materially aids in increasing the actual length of this tendinal passage, by closing up the posterior gap.

The os furcula has a form about intermediate between the usual U- and V-shapes of the bone. Regarding it from a lateral aspect, the actual form of one of its transversely compressed heads can be better appreciated, as well as its method of articulation with the other bones of the girdle. This part of the skeleton of *Geococcyx* has all been figured in my former memoir on its osteology in the *Journal af Anatomy*.

Below it is flattened in the antero-posterior direction, and termin-

ates in an elongated hypocleidium. This latter articulates when the arch is *in situ* with the carinal angle of the sternum, in the manner described in a foregoing paragraph.

A scapula assists to form the glenoid cavity in the usual way, contributing about half the surface to that humeral socket. Its clavicular process reaches far forward, to make an extensive articulation with the head of the furculum, when the bones are in the position they assume in life. It also rests further forward upon the scapula process of the coracoid than is usually seen among birds. Sometimes we find the posterior third of the long, narrow blade of this bone bent down more abruptly than in the specimen I have figured in my former memoir, and its end is always rounded off, rather than being truncated, as is commonly the condition in Aves.

At the outer and back part of the shoulder-joint in the adult *Geococcyx* occurs usually a very minute sesamoid, known as the os humero scapulare, and I am led to believe that small sesamoids may yet be found in other of the tendons of the pectoral extremity in this region.

Of the Appendicular Skeleton. The Pectoral Limb.—Pneumaticity is extended only to the bone of the brachium in this limb, the hollow shafts of the other long bones being charged with medullary substance.

The humeral shaft is much bowed, and in such a manner as to be convex along its radial border and concave upon the opposite side, which concavity is more apparent owing to the prominence of the ulnar crest and the peculiar projection of the distal extremity in the continuity of this curve.

In form the shaft is nearly cylindrical and almost entirely devoid of muscular lines.

At the proximal end, a well-marked valley occurs between the ulnar crest and the spindleform humeral head. The former has barely any pneumatic fossa at its base, the circular foramen there found being nearly flush with the general surface of the bone. On the opposite aspect we find a short though prominent radial crest, which makes no pretence to extend its lamelliform plate down the shaft, as we often find to be the case in birds.

The distal extremity of this bone presents for examination the usual oblique and ulnar tubercle, while, as already alluded to, the ulnar condyle of this end is much produced and very prominent.

The anconal aspect immediately above the trochlea is flat and

smooth, the opposite side showing a broad, shallow groove for the guidance of the tendons to the antibrachium. A fairly well developed "ectocondyloid tubercle" is seen at its usual site, on the radial border of the shaft just above the oblique trochlea.

Following the example of the humerus, we find the comparatively short radius and ulna very much bowed along the continuity of their shafts. This gives rise to a broad spindle-shaped interosseous space, the two bones only coming in contact at their distal and proximal extremities when articulated.

The radius is not nearly so much bent as the other bone of the antibrachium, and presents nothing peculiar about it. On the other hand, the ulna, with its greatly curved shaft, its prominent row of secondary papillæ and its well-developed olecranon, is quite a striking bone beside it.

Composing the elements of the carpus, the two usual free segments are seen; of these, the radiale has pretty much the same form as it assumes among birds generally, while the ulnare takes on an entirely different shape. It does not develop the two limbs or processes that straddle the proximal extremity of the carpo-metacarpus when the bones are *in situ*, as in the vast majority of the Class, but is simply a bar of bone, with one end enlarged and bearing at its summit an articular facet for the ulna.

The carpo-metacarpus is chiefly interesting for its peculiarly formed mid-metacarpal. This is uncommonly broad at its proximal end and curiously twisted as it descends to anchylose with the lower end of the index metacarpal, or main shaft of this compound bone. So far as I have been enabled to discover, the phalanx of pollex-digit does not bear a terminal claw, and the bone has the usual form as seen in most birds. Nothing of note distinguishes the two phalanges of the index digit, while the small phalanx of the last finger develops, at the middle point of its hinder margin, a curious little upturned spur.

Of the Pelvic Limb.—As in the pectoral extremity, the proximal long bone of this limb, the femur, is the only one in it that enjoys a pneumatic condition. The site of the foramen that admits the air to its hollow shaft is, however, quite unique, being upon the posterior aspect of the bone, between the trochanter and head, instead of on the anterior side, as usual, below the trochanter.

This latter feature is not elevated above the articular surface at the summit, and the semi-globular head is, comparatively speaking,

rather small. A shallow excavation upon its upper side marks the usual point for the insertion of the round ligament.

The subcylindrical shaft faintly showing the muscular lines is considerably bent to the front, and at its distal extremity in that situation the rotular channel is well marked, the condylar ridges bounding it being about parallel to each other.

The outer and larger condyle of the two is at the same time the lower, and the fibular cleft that marks its posterior aspect is very wide and deeply sculpt, being rather more to the outer side than is usual.

Above these condyles, behind, the popliteal fossa is but moderately excavated, and a straight transverse line bounding it below divides it from the general trochlear surface.

We find in the next segment of this limb, the tibio-tarsus with a subcylindrical shaft below its fibular ridge that is slightly bent so as to be in the vertical line, somewhat convex anteriorly. The bending here though is not nearly so great as we find it to be in the humerus and femur or, to make the comparison more exact, in the ulna.

The cnemial crest of this leg-bone is but little raised above the undulating articular surface of its summit, while the pro- and ecto-cnemial ridges that develop below it are not peculiar.

Their planes are not at right angles to each other, that of the latter having its surface facing directly to the front. Neither is produced for any distance down the shaft of the bone, but they terminate rather abruptly upon it; the procnemial ridge terminates at a point about opposite the superior end of the fibular ridge on the other side of the shaft.

At the distal extremity of the tibio-tarsus the planes of the condyles are nearly parallel to each other, and these trochlear eminences are strikingly close together in *Geococcyx*.

The intercondyloid fossa is deeply excavated in front, to become suddenly much shallower behind as well as somewhat narrower. Upon lateral view it will be seen that the general outline of either of the condyles is more circular than we usually find it in others of the Class, where a reniform pattern prevails.

Just above the condyles, on the anterior aspect, the vertical tendinal channel is spanned by the usual little oblique bridge of bone, and this is supplemented in life by a longer ligamentous one placed in front of it.

The fibula has a large head, which is produced backward beyond its shaft. This latter makes a close ligamentous articulation with the fibular ridge of the tibio-tarsus, and at some little distance below it merges into its shaft to become almost indistinguishably fused with it.

A well-developed subcordate patella, with its apex directed below, is found in the usual tendon in *Geococcyx*.

The tarso-metatarsus of the Road Runner is a longer bone than we would be led to expect, had we in our possession but the other long bones of this limb to judge from.

Its summit presents for examination the two concavities for the condyles of the tibio-tarsus, separated by the mid-tubercle. Behind this we find a short hypotarsus, showing two vertical grooves at its back and two vertical perforations through it.

The sides and front of this bone are flat, the latter for its proximal half being longitudinally grooved, deepest above, gradually becoming shallower as it descends. Posteriorly it is likewise grooved in a somewhat similar way; but here the outer wall of the groove is raised as a sharp longitudinal crest, best marked at the middle third of the shaft and gradually subsiding toward the extremities.

At the distal end we note the three usual trochleæ for the basal joints of the toes, as shown in fig. 27 of my former memoir; however, in this zygodactyle bird the outer one of these is extended to the rear in such a manner as to allow the fourth toe to articulate in that direction.

Of these trochleæ the middle one is much the largest and is placed the lowest down; it is the only one of the three that shows the distinct median groove. The trochlea for the fourth toe is much elevated, while the inner one holds about a mid-position in this respect.

A well-developed accessory metatarsal, slung by a ligament in the usual way, is found between the shaft and the basal joint of the hallux. The perforating foramen for the passage of the anterior tibial artery is small and inconspicuous, being at the same time quite low down on the shaft.

The joints of these podal digits are harmoniously proportioned, both as regards size and comparative length. Beyond being typically zygodactyle, they offer nothing of particular note.

Before reducing my specimens to skeletons I failed to make any

special examinations as to the condition of the ossifications of the columella auris in the adult *Geococcyx*. I find, however, among other normal ossifications in this type some twelve or thirteen sclerotal plates in either eye, overlapping each other in a somewhat irregular manner. As in certain other birds, some of the tendons of the pelvic limb in old individuals of this Cuckoo are converted into bone, and small sesamoids may be found about the proximal extremities of the basal joints in the soles of the feet. The entire skeleton of the pelvic limb for *Geococcyx* is figured in my former memoir in the *Journal of Anatomy*.

Osteological Note Upon the Young of Geococcyx californianus.

My collection contains the skeleton of the nestling of the Cuckoo now under consideration, secured at the time immediately before the bird quits the nest. This skeleton is disarticulated, and, like all the skeletons of immature birds, offers a very instructive object for study.

Several years ago, as I have said in the Introduction above, I published in the London *Journal of Anatomy* (Vol. xxi, p. 101) an observation upon the tibio-tarsus of the pelvic limb to this skeleton, and the substance of these remarks with addenda are herewith incorporated.

It is a well-known fact that the proximal extremity of the tibio-tarsal shaft is much larger and more bulky in the young of certain birds than it is in the adults of the same species.

This is very appreciably the case in many Gallinaceous fowls, and I have already remarked upon it as a striking feature in the skeleton of the young of *Centrocercus urophasianus;* while in our present subject, this immature *Geococcyx*, this condition obtains to an extent unequaled, so far as my observations go, by any of the *Gallinæ*.

Further, that portion of the tibio-tarsus, which in the old bird eventually becomes the antero-superior part of the shaft, and supports the pro- and ectocnemial processes, is in the young individual developed as a separate epiphysis. Formerly, from careful examination of material, it appeared to me that this epiphysis was superadded to the true epiphysis of the summit of the shaft of this bone of the leg, and thus corresponded to the olecranon of the ulna. (See

Proc. U. S. Nat. Mus., Vol. vii, 1884, p. 324.) Upon carefully re-examining this material at the present writing it certainly seems that this is the case, but I would prefer to microscopically investigate a series of these bones of all ages and properly stained before restating the opinion.

In *Geococcyx* the proximal end of the tibio-tarsus appears to possess a terminal epiphysis, something similar to what we see in the Frog, and to this is super-added the additional piece, as already stated above; and as age advances in the individual the proximal third of the shaft, so much larger than it actually is in the adult, becomes gradually absorbed so in time to be equal to it in size. (See Pl. I, Fig. 6.) This is very curious. The lower two-thirds of the bone in the young has a calibre proportionately less than the corresponding part in the adult and is in harmony with the size of the bird.

I regret to say that ossification had proceeded so far in this specimen that I was unable to determine anything beyond the single segment at the distal extremity of the bone, and additional material is required for me to decide whether or no the intermedium, as described by Morse, develops in *Geococcyx* as a separate ossicle.

In this young bird the pelvis already exhibits all of those peculiar features, which makes it so interesting a subject for study in the adult, while points of somewhat minor importance are to be noted in other parts of the skeleton. The anterior half of the sternum is quite complete, and all in one piece, while its posterior portion is entirely in cartilage, and as yet gives no hint as to the form it will eventually assume—even the xiphoidal prolongations not being indicated.

On the Osteology of Crotophaga.

Through the courtesy of the U. S. National Museum I have the following osteological material before me to illustrate the skeleton in this extraordinary genus of Cuckoos, representing as they do the subfamily *Crotophaginæ*. First, nearly a complete skeleton of *C. sulcirostris* (No. 6467); the sternum, shoulder-girdle and ribs of a specimen of *C. rugirostris* (No. 7048); finally, the same bones from a skeleton of *C. ani* (No. 432, Bryarth coll.). (See Pl. II, Figs. 8, 9 and 11.)

In some few particulars there is a curious resemblance between the lateral view of the skull of *Crotophaga* and the same view of the

skull of the Common Puffin (*Fratercula*), but upon careful scrutiny we at once see that *Crotophaga* possesses a true cuculine skull, and one that, for at least the posterior moiety of the basal aspect of its cranium, reminds us not a little of Huxley's figure of *Cuculus canorus* (P. Z. S., 1867, p. 444, Fig. 26). Among our Cuckoos, however, *Coccyzus* is the bird that appears to have a skull most like *Cuculus*, and *Crotophaga* upon the lateral view of its skull reminds us of neither of those species.

Regarding the skull of this Ani upon its upper aspect, we are enabled to see how the subcompressed, lofty superior osseous mandible mounds up mesially just in front of the very distinct craniofacial line. The culmen is sharp and arches over handsomely to the tip of the decurved apex of the beak. The small subcircular nostrils can also be partially seen upon this view and the minute foramen that perforates either nasal bone. The large lacrymals have much the form they have in *Geococcyx* and articulate with the surrounding bones in precisely the same manner. Longitudinally, in the middle line, between the orbits, the frontal region exhibits a moderately-raised, rounded eminence, extending backward upon this aspect as far as the vault of the brain-case; and this interorbital space is quite broad in *Crotophaga*—proportionately much more so than it is in *Geococcyx*.

This breadth is likewise enjoyed by the smooth, rounded superficies of the cranial vault.

Laterally this skull presents a well-marked temporal (crotaphyte) fossa; a small post-frontral process directed downward, and a much larger arched squamosal one directed forward and only slightly downward.

The quadrato-jugal bar is straight and slender between quadrate and lacrymal, while the small sesamoid at its posterior end seems to be in a ligament passing from it to the os quadratum.

The capacious orbits are only separated from each other by a thin, incomplete septum, and the foramina in the anterior wall of the brain-case are large and may merge to some extent.

Os quadratum is large, with a good-sized orbital process. Its various projections are thin and compressed, while a deep notch separates its two mandibular facets. Pars plana is also of good size, fusing with the frontal above, where it is pierced internally by a single foramen (two in *Geococcyx*); its infero-external angle being somewhat drawn out into a stumpy apophysis. This osseous

partition aided by the large, descending part of the lacrymal forms a very efficient bulwark between the orbit and the rhinal chamber; while, laterally, in front of the last mentioned bone quite a sizable vacuity exists ere arriving at the posterior edge of the nasal.

The base of this vacuity is spanned by the slender maxillary. Either aural entrance is capacious, and underspanned by a fairly well-developed tympanic bulla. A side of the osseous superior mandible is flat and nearly smooth, being only slightly scarred by delicate vascular venations. Passing next to the base of this skull we find the basitemporal region smooth and rather contracted, the tympanic bulla dipping down considerably below it upon either hand. A pointed bony shield underlaps the anterior entrance to the Eustachian tubes, and the foraminal apertures for the hypoglossal and vagus nerves, and the carotids are very small and inconspicuous. The lower border of the sphenoidal rostrum is narrow and rounded, while either pterygoid is somewhat short, straight and characterized by a raised and sharpened superior border for its anterior two-thirds. These bones articulate far forward from the cranial base, and no sign whatever is seen of basipterygoidal processes.

For their major part the palatines lie in the horizontal plane, they being for their lengths nearly of uniform width, and their postero-external angles are very much and completely rounded off. They are in contact along the middle line next the rostrum but do not seem to fuse together there, and their supero-mesial margins are produced forward into a single and diminutive spicula of bone, which possibly represent the vomer. *Crotophaga* is desmognathous by the fusion of its delicate and spongy maxillo-palatines across the middle line. Indistinguishably fused with these seems to be an osseous septum narium, and the spongy osseous tissue that fills in the hinder moiety of the cavity of the upper mandible. The prepalatine portions of the palatines are in intimate contact with the maxillo-palatines, while anteriorly these horizontal plates become continuous with the flat bony roof of the nether surface of the osseous beak; quite as we fine them in all of our *Cuculidæ*.

With respect to the mandible, we find it of the V-shaped pattern, with a moderately deep symphysis, the latter being concaved above and roundly sharpened along the median line below. The ramal sides are of nearly uniform depth throughout and are by no means narrow; the interangular vacuity behind being small (Pl. II, Fig. 8).

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Either articular cup is well concaved, with its inturned process much produced and spine-like. Behind, the process is short and stumpy. Comparatively speaking it is a stronger lower jaw than has either *Geococcyx* or *Coccyzus*.

Typically cuculine, the delicate hyoidean arches of *Crotophaga* present us with little worthy of especial remark. They agree in the main with what was shown to obtain in those parts in the "Road Runner." We must note, however, that in the Ani the ceratohyals are but mere granules of bone that neither fuse with nor meet each other, but simply rest against the anterior tip, on either hand, of the first basibranchial.

I have not examined the sclerotal plates of the eye, nor the intrinsic bones of the ear. They were lost from my specimens.

Beddard has said that

"*Crotophaga ani* is well known to possess a bronchial syrinx, which may be considered as more specialized than that of *Geococcyx* and *Pyrrhocentor*, in that the membrana tympaniformis is limited to the posterior bronchial rings, commencing with about the seventh, and does not extend up to the point of bifurcation of the bronchi; in this respect the syrinx of *Crotophaga* resembles that of *Steatornis*, which has been carefully described by Prof. Garrod." [1]

As in that bird, the bronchi arise from the trachea much as they do in the Mammalia; the first nine rings of each bronchus are entire; the tenth and eleventh rings are considerably wider from side to side, and their extremities are connected by membrane which forms the inner neck of the bronchus; the succeeding rings become gradually narrower and are similarly completed internally by membrane. In *Steatornis* the membrana tympaniformis is only of limited extent, the posterior rings of the bronchi being, like the anterior rings, complete; in *Crotophaga* this is not the case—all the bronchial rings, commencing with the seventh, are semirings; there is a single pair of slender intrinsic muscles attached, one on each side of the tenth bronchial semiring.[2]

As in the case of *Geococcyx*, *Crotophaga* has *eighteen* free vertebræ between the skull and the pelvis, and although these have the same general characters as the corresponding segments in the spinal column of the Ground Cuckoo, they have special features of their own. For instance, the fifth to the eighth cervicals develop a

[1] *Coll. Scientif. Papers*, p. 188.
[2] *P. Z. S.*, 1885, p. 173.

slender osseous bar, on either side, joining the pre- and postzygapophyses, a character that gradually disappears in the next few succeeding vertebræ. Again, we see strong, median hypapophyses in the last cervicals and some of the leading dorsals, and the neural spines to the latter are much as we find them in *Geococcyx* only being one or two more in number. *Crotophaga* seems in the main to agree also in the nature and arrangement of its ribs; they differ, however, in the specimens before me by having a very rudimentary pair on the *twelfth* cervical. There is also a peculiar pair of short, stumpy ribs, detected considerably *backward*, articulating with the first vertebra of the pelvis.

The skeleton of the tail agrees practically with the same part of the bird as we find it in *Geococcyx*, and this remark essentially applies to the pelves of these species of Cuckoos—though in *Crotophaga* the ilia behind do not curl outward quite so much in proportion, and the prepubic spine or process is relatively not so large.

As to their *shoulder-girdles*, *Crotophaga sulcirostris* and *Geococcyx* agree pretty well, though in the former bird we find very notably narrow scapulæ,—long and pointed, while the hypocleidium to the os furcula is relatively as large as we find it in most passerine birds, being curved backward and upward, when the bones are *in situ*, and occupies the lower part of the recess formed by the anterior concaved border of the sternal keel. Os furcula itself is more broadly rounded below than it is in *Geococcyx*. In other species of *Crotophaga* these characters are not quite so strongly marked, approaching, perhaps, more nearly what we see in the Ground Cuckoo.

One would now naturally suppose from the number of points of agreement in the trunk-skeletons of these two species thus far enumerated, that we would surely find their sterna modeled upon the same plan. This, however, is by no means the case, for although *Crotophaga sulcirostris* has essentially a cuculine sternum, with a relatively deeper carina than has *Geococcyx*,[1] it differs radically in the xiphoidal portion of the bone, for it has but one rather shallow notch upon either side; whereas, as we have seen, *Geococcyx* agrees with *Coccyzus* in possessing two. In *Crotophaga ani* this shallow notching of the xiphoidal margin of the sternum

[1] This deeper sternal keel we might naturally expect to find, being a character often seen when we come to compare birds that are by nature flyers, with those that habitually spend the most of their time upon the ground.

is carried to its mininum, and almost entirely disappears, the border of the bone in question well-nigh becoming *entire*.

Being constructed upon exactly the same principle, I find nothing especial requiring description in the pectoral limb of *Crotophaga*, further than what has already been given above for *Geococcyx*. (See Pl. II, Fig. 9.) Practically the characters are the same in all the bones composing the skeleton of this extremity in these two Cuckoos, and I also find that a small os humero-scapulare is present in the *Anis*.

With respect to the pelvic limb, this statement applies with almost equal truth, though in *Crotophaga* the procnemial process of the tibio-tarsus is not as well developed; it has but a *single* tendinal perforation through the hypotarsus of the tarso-metatarsus, and that process is peculiarly capped off by a plate of bone; and, finally, in *Crotophaga* the longitudinal excavation adown the anterior aspect of the tarso-metatarsus is, comparatively speaking, much deeper than it is in *Geococcyx*. Aside from these apparently minor differences the skeletons of the pelvic limbs of these two cuculine types are fundamentally the same.

The Genus Coccyzus Osteologically Considered.

Forms of this group, as *C. americanus*, have a skull, with its associated skeletal parts, very much like *Geococcyx*, and quite different from what we have just described above for *Crotophaga*. (See Pl. II, Fig, 7.) So much is this the case that I will not enter upon a detailed description of the skull of *Coccyzus* but rather give some of the chief departures it makes from the corresponding characters as they occur in that part of the skeleton of the Ground Cuckoo.

In *Coccyzus*, and essentially too in *Centropus* and *Diplopterus*, the structure of all the osseus parts of the superior mandible practically agree, both in form and relations, with what we find in *Geococcyx*. The former species, however, has a relatively shorter and broader bill, but its maxillary processes, at the same time, are not only relatively, but (usually) actually longer than they are in *Geococcyx*.

A lacrymal bone in *Coccyzus* has its descending portion only represented by an outwardly-curved, delicate spicula of bone; the structure as a whole reminding us very much of the lacrymal as we find it in many of our *Tetraonidæ*.

This is by no means the case, however, in *Centropus* and in *Diplopterus nævius*, where in both these genera the lacrymal bones

are, comparatively speaking, large and conspicuous, especially in the last-named species (see Pl. II, Fig. 15).

Posteriorly, the crotophyte fossæ of *Coccyzus* more nearly approach each other than they do in *Geococcyx*, and a pterygoid in the former species develops a raised, thin crest on the superior aspect of its anterior moiety, a character I do not find at all in the Road Runner. These fossæ are very deep in *Centropus superciliosus* and nearly meet behind, while in *Diplopterus nævius* they are shallow and widely separated posteriorly.

Coccyzus may or may not possess a minute spiculiform vomer. I have examined adult fresh specimens to decide this very point, and have found old individuals where this element was undoubtedly missing, while I have found it very feebly developed in others.[1]

Turning next to the remainder of the skeleton we find eighteen free vertebræ between skull and pelvis in the spinal column, as in *Centropus* and *Diplopterus nævius*, and their characters are essentially the same as I have described them for *Geococcyx*. This statement also applies to the caudal vertebræ, but the number and arrangement of the ribs do not either agree with the Ground Cuckoo nor with the Ani.

There are three pairs of free cervical ribs; four pairs of dorsal ribs that connect with the sternum by hæmapophyses; and finally, a pair of pelvic ribs that lack epipleural appendages and whose costal ribs do not quite succeed in reaching the costal border of the sternum. This last pair appear to be absent in *Diplopterus nævius* (Pl. II, Fig. 14).

The pelvis is cuculine in its general character, but differs considerably from the pelvis of *Geococcyx*. Its ilia curl but little over the ilio-ischiac foramen upon either side, and the coalescence between the internal margins of the ilia and the sacral crista is more thorough. The prepubis is very small. In none of the N. American Cuckoos are the parapophyses of the sacral vertebræ opposite the acetabulæ upon the ventral aspects of the pelvis, especially length-

[1] Especial attention is invited to the morphology of the external narial apertures of the superior osseous mandible of *Geococcyx*, *Coccygus*, and *Crotophaga*. In the latter they are clean cut, subcircular, and comparatively small: while in *Geococcyx* and *Coccygus* they are large and subelliptical, but more or less masked by the bony lamina that extends over them, leaving in the case of the first-mentioned species a rather small anterior narial aperture, with usually two apertures in *Coccyzus*, an anterior and a posterior one. They are small and fairly clean cut in *Diplopterus nævius*, but large and triangular in *Centropus*.

ened and strengthened to act as tie-beams to brace the line of pressure between the femora.

In *Centropus superciliosus* the prepubic spines of the pelvis are conspicuously produced, while the postpubic element upon either side extends but very little beyond the bone above it posteriorly. Then in the curious pelvis of this Cuckoo the ilio-neural grooves are very short and are arched over simply by the much antero-posteriorly compressed arches of one of the included vertebræ (Pl. II, Fig. 13). In *Diplopterus nævius* these grooves are open and shallow, while the slender postpubic elements sweep far out behind, and the prepubic spine is barely noticeable. In other words the pelves of these two Cuckoos are essentially very different. *Centropus* has all the main cuculine characters well pronounced, while the pelvis in *Diplopterus* closely resembles that part of the skeleton in some of the passerine birds.

Several interesting points are presented on the part of the bones composing the shoulder-girdle in *Coccyzus*. A scapula is comparatively not quite as long nor as narrow as we find it in *Crotophaga*, and its posterior fourth, in some specimens, is inclined to be broadened, and bent slightly outward. At the sternal end of a coracoid, at its outer side, we meet with a conspicuous, upturned and sharpened process. The hypocleidium of the os furcula of some specimens of *Coccyzus americanus* is of a peculiar form, having a crescentic shape with the concave aspect of the line looking toward the manubrium of the sternum.

Comparatively shorter and broader than we find it in *Geococcyx*, this latter bone nevertheless practically agrees with the sternum of the Ground Cuckoo and with *Diplopterus*.

Its deeper keel has still the true cuculine pattern, and there are two notches upon either side of it, behind, and these are deep in the last named genus. Of the xiphoidal processes thus formed the strong outer pair possess dilated hinder ends, while the weaker inner pair are, upon either side, inclined by their posterior tips toward the postero-external angles of the mid-portion of the xiphoidal prolongation. In some of the Bornean *Meropidæ* these tips fuse at the angular points just mentioned. As in all N. American *Cuculidæ*, the sternum is a very thoroughly pneumatic bone.[1]

[1] A number of the skeletal characters in the case of *Coccyzus* are liable to vary and depart to some extent from the descriptions I am here giving; among which are the depth of the xiphoidal notches; the form of the hypocleidium of

Some points of interest are to be seen in the trachea of *Coccyzus*, for in this Cuckoo, the tracheal rings differ very markedly from what we found to be the case in *Geococcyx*, in that some of them are as fully and completely ossified as are any of the tracheal rings among the *Passeres*. This is likewise the case in *Centropus*. The pessulus also ossifies, as do the arytenoid bones and the thyroid plate.

As for the hyoidean apparatus it seems to agree with the skeleton of it in all ordinary Cuckoos, and practically agrees with the corresponding parts in *Crotophaga*.[1]

No especial nor detailed description is required for the pectoral and pelvic limbs of *Coccyzus*. The skeleton of these parts is cuculine in all particulars, differing but little from what has already been described above for other United States Cuckoos.

In the case of the pelvic limb, this genus of birds agrees with *Crotophaga* in that pro- and ecto-cnemial processes of the tibio-tarsus are quite feebly produced; while, on the other hand, the hypotarsus of the tarso-metatarsus agrees with the corresponding apophysis as we found it in *Geococcyx* in that it exhibits two vertical perforations for the passage of tendons, instead of one, as we found to be the case among the Anis. *Coccyzus* also has the fibula short and weak, and the patella in this Cuckoo is comparatively very small.[2]

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the os furcula; the amount of fusion engaged in between the sacral crista and the internal margins of the ilia, and other points; and this remark applies to a number of other species and genera of the Tree Cuckoos.

[1] This statement must be taken only tentatively, for personally I rely upon Beddard's description of the ossifications of the trachea in *Crotophaga*, and a fuller examination of the trachea in *Coccyzus* may go to show that the parts are more alike in *Coccyzus* and *Geococcyx* than in *Coccyzus* and *Crotophaga*. It is a point that requires more extended examination. In fact all these structures need a much fuller research than they have as yet had bestowed upon them.

[2] Since the above account was written I came across some special notes that I had made and set aside five or six years ago upon the skeleton of *Diplopterus nævius* in the collection of the U. S. National Museum, and although these notes duplicate one or two of the statements already made above, they are sufficiently full in other particulars to warrant their being inserted here as a footnote to render the account of the osteology of that species more complete. They run as follows:

In *Diplopterus nævius* the superior osseous mandible is considerably shorter than the remainder of the skull, measuring from the very distinct cranio-facial line.

Its culmen is rounded and the whole bill decurved, while the external narial

NOTES ON THE SKELETON OF A NESTLING OF COCCYZUS AMERICANUS.

Allusion has already been made in a former paragraph of this memoir to the material here to be considered. The skeleton I have

aperture is much as we find it in *Geococcyx*. The frontal region is narrow, concaved, and the cranial vault agrees in form with that region in *Coccyzus*.

The temporal or crotaphyte fossæ, though well marked, are confined to the lateral aspect of the skull. Postfrontal and squamosal processes agree better with what we found in *Crotophaga sulcirostris*, while the quadrate agrees in form with that bone in the average cuculine types. The central portion of the interorbital septum is very deficient in bone, as in the Ground Cuckoos. A pars plana is ample, quadrilateral in outline and exhibits a single nervous foramen above it. The lacrymal practically agrees with that bone as it is seen in *Geococcyx*, as does the quadrato-jugal rod. Turning to the base of the cranium, we find a pterygoid to agree with the corresponding element in *Coccyzus*, with its superior crest still better marked. The palatines, although cuculine in their general features, are peculiar, for their prepalatine portions are markedly narrow, their widest parts being at the middle of the postpalatines, and finally a distinct, spiculiform process of no great length juts out from either postero-external angle.

A rudimentary spine-like vomer may be present. Posteriorly, the backward-extending bulbous ends of the maxillo-palatines are well separated in the median line, and it is only anteriorly that desmognathism is shown by the fusion of these processes with the mass of spongy bone tissue occupying the forepart of the rhinal chambers.

This last seems to be deposited about a true osseous septum narium. Either nasal is perforated by a minute foramen, to which I have invited attention in other Cuckoos and the Kingfishers: internally one of the elements develops an osseous spine that is sent downward and inward toward the maxillo-palatine of the same side. The maxillaries are typically cuculine.

The mandible is V-shaped, decurved, with short symphysis and small ramal vacuity.

Diplopterus nævius has eighteen free vertebræ between skull and pelvis, with the ribs arranged just as we find them in *Geococcyx;* it differs, however, in having six free vertebræ in the skeleton of the tail, with a pygostyle that differs somewhat in form with that bone in both *Coccyzus* and the *Centropodinæ*, in that its postero-superior angle is not drawn upward so as to be rather more prominent than its antero-superior angle—which feature is best seen in *Coccyzus*. The bones of the shoulder-girdle are characteristically cuculine, with the scapulæ long and very narrow, as in *Crotophaga sulcirostris*.

In the form of its sternum it agrees with *Coccyzus americanus*, but shows a few distinctive features in its pelvis, for in *Diplopterus* the ilia anteriorly are more decidedly separated from the sacral crista, and the postpubic elements are well drawn out behind as inturned slender spines, as we see them in many *Passeres*. Otherwise the pelvis of this interesting Cuckoo does not differ so very much from that bone of the skeleton as it occurs in our genus *Coccyzus*.

prepared from the alcoholic specimen exhibits some few points of interest. In the skull I find a nasal bone to have the same form as the nasal of an immature *Geococcyx*, and indeed the entire building up of the skeleton of the head in these two types of Cuckoos seems to be quite similar. With respect to the trachea, my examination of it inclines me to believe that the majority of the rings are entire, especially in the superior half of it. Still more interest attaches to the development of the sternum of this chick of the Yellow-billed Cuckoo, for it, too, ossifies in precisely the same way that that bone does in *Geococcyx*. Its anterior moiety is already in bone, and in one piece only: the posterior part is in cartilage and distinctly shows the xiphoidal notches, two upon either side of the low semi-developed carina. This is very different from what we find in the *Gallinæ*, a group of birds wherein it was shown that the sternum ossifies from several centres, the pieces not fusing together until the bird is nearly a year old.

There are eleven vertebræ in the pelvic sacrum of this young *Coccyzus*, but no special attempt was made to determine how many entered into the formation of the pygostyle. Nor was the microscope brought to bear upon its carpus and tarsus with the view of working out the morphology of the embryological elements that enter into the formation of those two interesting joints in this species.

Synopsis of the Principal Osteological Characters of the Three Subfamilies of the United States Cuculidæ.

Subfamily Crotophaginæ.

Crotophaga ani.

Crotophaga sulcirostris.

1. Superior osseous mandible deep in vertical direction, somewhat compressed transversely; culmen sharp, decidedly curved, mounded in front of transverse line of cranio-facial hinge.

2. External narial apertures small, sharply defined and subcircular in outline.

3. Frontal region broad, convex.

4. Temporal fossæ deeply sculpt; approach moderately behind.

5. Postfrontal process short; squamosal process long. Quadrate large with its processes much compressed. Quadrato-jugal bar

slender. Pars plana large. Interorbital septum thin, large central perforation.

6. Lacrymal large, its descending part lamelliform, broad.

7. Basipterygoid processes completely aborted. Pterygoids straight, moderately long, sharp on superior border.

8. Vomer rudimentary: Palatines plate-like, comparatively broad and placed horizontally, with their postero-external angles completely rounded off. Maxillo-palatines large, spongy, in contact in median line, and with several of the surrounding bones, but not with the vomer.

9. Mandible V-shaped, sides rather deep, ramal vacuity small; angular processes stumpy, with the inturned ones long. Mandibular symphysis less than a third the length of the jaw.

10. Elements of hyoidean arches slender; basibranchials short, separate bones; cerato-hyals very small, not in contact.

11. Eighteen free vertebræ between skull and pelvis; cervical ribs on the twelfth, thirteenth and fourteenth. Four pairs of dorsal ribs, of which the three anterior pairs connect with the sternum. One pair of very short pelvic ribs, directed backward. Pelvis peculiar; anterior ends of ilia dilated, and their inner tips meet the "sacral crista:" posterior to this they are contracted and are not in contact with it. Small prepubic process present, and the ilia, on either side, curl outwardly over the ischiac foramen. Postpubic bones project but very slightly behind. Five caudal vertebræ and a pygostyle; the three last ones of the former having large hypapophyses.

12. Os furcula U-shaped, slender, with large hypocleidium, and articulates with both scapula and coracoid above. Blade of scapula long and narrow. Coracoid long with rather slender shaft.

13. Sternum short, moderately wide, with one pair of rather shallow xiphoidal notches. (These latter are barely noticeable in *C. ani.*) Costal processes conspicuous. Manubrium small. Carina subample, with its border concaved in front, forming a prominent carinal angle. Pneumatic.

14. Humerus longer than either radius or ulna; radial crest short; shaft having the sigmoidal curve. This bone is pneumatic, and the pneumatic fossa is very shallow and the foramen usually single. Radius is straight and slender; the ulna is bowed and stout, and has down its shaft the row of papillæ for the insertion of the quill-butts of the secondary row of feathers. Carpal bones two.

Medius metacarpal well bowed-out from the metacarpal of index digit. Osseous digits long: blade-portion of the proximal phalanx of index digit entire. A notable process at the medio-posterior margin of the medius digit.

15. Bones of pelvic limb long and slender, and apparently non-pneumatic. Femur slightly bowed forward. A small patella present. Fibula feebly developed. Pro- and ecto-cnemial crests of tibio-tarsus somewhat reduced, and the hypo-tarsus of tarso-metatarsus once perforated for tendons, with lateral grooves for the passage of the same. These grooves are formed by the process being capped with a lamina of bone. Anterior aspect of tarso-metatarsus longitudinally grooved for its proximal moiety.

Podal digits run 2, 3, 4, 5, for the 1–4 toes respectively, and the fourth toe is permanently reversed.

Subfamily Centropodinæ.

Geococcyx californianus.

1. Superior osseous mandible not especially deep in vertical direction; comparatively broad at base; culmen broadly rounded, very gently curved; being below the level of the frontal region at the line of the cranio-facial hinge.

2. External narial apertures situated rather far forward, and small only from the fact that the true nostril is permanently and largely sealed over by an osseous lamina continuous with the side of the mandible. Osseous nostril large in nestling.

3. Frontal region only moderately broad, and is concaved.

4. Temporal fossæ well-marked, and well separated behind.

5. Postfrontal and squamosal processes of nearly equal length. Quadrate, quadrato-jugal bar, pars plana and interorbital septum much as in *Crotophaga*. Two foramina for nerves over pars plana, only one in *Crotophaga*.

6. Form of lacrymal a good deal as we find it in the Anis.

7. Basipterygoid processes completely absorbed. Pterygoids as in *Crotophaga* but superior margins not especially sharpened, and with a rudimentary "epipterygoid hook" present.

8. Vomer always present in adult; small, spiculiform, rod-like and free. Palatines agree mainly with *Crotophaga*, but their postero-external angles more abruptly rounded off. Maxillo-palatines as in the Anis.

9. Mandible U-shaped, sides rather shallow; ramal vacuity large; angular processes nearly aborted, with the inturned ones moderately long only. Mandibular symphysis about one-fourth the length of the jaw.

10. Elements of hyoidean arches slender, and practically agree with the corresponding parts in the Anis, but *Geococcyx* has the cerato-hyals more extensively ossified, and fused together anteriorly.

11. Eighteen free vertebræ between skull and pelvis; cervical ribs on the thirteenth and fourteenth. Four pairs of dorsal ribs, of which the three anterior pairs connect with the sternum. Pelvic ribs absent. Pelvis of extraordinary form; very strong and agrees practically with the bone in *Crotophaga*, but the ilia very conspicuously curled outwards behind, and the prepubic process very large.

Skeleton of the tail as in the *Crotophaginæ*.

12. Os furcula moderately U-shaped, somewhat slender; with rather long but narrow hypocleidium. Other bones of this girdle agree in the main with the corresponding ones in our other Cuckoos, but the scapulæ are comparatively not as narrow, and their apices are more rounded posteriorly.

13. Sternum of the same general pattern as in all North American Cuculidæ, but differs from the *Crotophaginæ* in being twice notched upon either side of the keel, which notches are comparatively much deeper, while the carina is relatively shallower. The bone is thoroughly pneumatic.

14. Skeleton of the pectoral limb essentially agrees with what has been recorded above for the *Crotophaginæ*. Osseous papillæ on the shaft of the ulna very prominent. The bowed shaft of the medius metacarpal wide and ribbon-like, slightly twisted upon itself.

15. Bones of pelvic limb long and stout, with the femur pneumatic. Patella, comparatively speaking, rather large. Fibula very feebly developed below the articular ridge on tibio-tarsus. Procnemial crest short and prominent, and the hypotarsus of the tarso-metarsus twice perforated for the passage of tendons. Anterior aspect of tarso-metatarsus, nearly flat for its proximal moiety.

Skeleton of pes essentially agrees with our other *Cuculidæ*.

SUBFAMILY CUCULINÆ.

Coccyzus minor.

Coccyzus minor maynardi.

Coccyzus americanus.

Coccyzus americanus occidentalis.

Coccyzus erythropthalmus.

1. Superior osseous mandible but slightly longer than the remainder of the skull. Broad at base, and somewhat compressed vertically; decurved more than in *Geococcyx* and with the culmen similarly rounded.

2. External narial apertures as in *Centropodinæ*, but the overlying lamina not so extensive, and usually leaves *two* openings upon either side of this mandible, one anterior to the other.

3. Frontral region somewhat narrow and concaved.

4. Temporal fossæ broad vertically, somewhat shallow and separated posteriorly only by the rather low supraoccipital prominence.

5. Postfrontal and squamosal processes much reduced. Quadrate as in *Geococcyx*. Quadrato-jugal bar slender. Pars plana essentially agrees with the corresponding part in *Geococcyx*, while the interorbital septum is more nearly entire than it is either in the *Crotophaginæ* or *Centropodinæ*.

6. Lacrymal not large, its descending process rather short, spiculiform, and turned outward. (Reminds us of the lacrymal bone in some of our *Gallinæ*).

7. Basipterygoid processes completely aborted. Pterygoids straight, relatively short, superior border in each raised and sharp.

8. Vomer rudimentary, or may be altogether absent. Palatines as in the *Centropodinæ*, while the maxillo-palatines agree with both the Ground Cuckoos and the Anis.

9. Mandible practically as in *Geococcyx;* sides shallow and the ramal vacuity large.

10. Structurally, the hyoidean apparatus essentially agrees with what we find in *Crotophaga* (but the tracheal ossifications do not seem to correspond in this subfamily with what we find in the *Centropodinæ*).

11. Eighteen free vertebræ between skull and pelvis; cervical ribs on the twelfth, thirteenth and fourteenth. Four pairs of dorsal ribs, all of which connect with the sternum by their hæmapophyses.

One pair of pelvic ribs that do not quite reach the sternum by their costal ribs.

Pelvis not strikingly peculiar, though cuculine in general pattern. Posteriorly, the ilia curl outward only very moderately, and the prepubic processes are quite vestigial in character. (Eleven vertebræ in sacrum of young *Coccyzus*).

Caudal vertebræ and pygostyle agree in the main with N. American *Cuculidæ* generally.

12. Os furcula U-shaped, slender, with luniform hypocleidium of good size. Blade of scapula not strikingly narrow, broadish distally, where it is sharp-pointed and slightly curved outward. A coracoid agrees closely with that bone as it is seen in *Crotophaga*, and in both it develops a conspicuous, upturned process at its sternal end at the outer angle of the dilated portion.

13. General pattern of sternum agrees with *Crotophaga* but the bone has two notches upon either side of the carina, as in the *Centropodinæ*. It differs also from both *Crotophaginæ* and *Centropodinæ* in possessing four facets for costal ribs upon either costal border.

14. Skeleton of pectoral limb cuculine, but possesses an individuality of its own. The humerus is a trifle shorter than either the ulna or radius; the bones of the antibrachium are straighter, especially the ulna, than they are in the other subfamiles. Os humero-scapulare, though small, is usually present in all of our *Cuculidæ*.

15. Bones of pelvic limb long and slender, and apparently non-pnuematic. They have some characters in common with the Anis, and some in common with the Ground Cuckoos. A small patella is present. Fibula feebly developed. Pro- and ecto-cnemial processes of tibio-tarsus reduced, and the hypotarsus of the tarso-metatarsus twice perforated for tendons, with lateral grooves for the passage of the same.

These grooves are formed by the process being capped with a lamina of bone. Anterior aspect of tarso-metatarsus quite flat.

Skeleton of pes upon the same plan as in other *Cuculidæ* characterized above.

Brief Discussion of Cuculine Kinships.

When we come to consider the affinities of the Cuckoos we are confronted with a more or less natural group of birds that have representatives in nearly all parts of the world. They are very different from any of the Suborders thus far treated of by me in

my previous memoirs, and they are to a greater or less extent structurally linked to a variety of other families of birds that have long puzzled both the ornithologist and the avian anatomist. By their zygodactyle feet they may at once be distinguished from any of the enormous group of the *Passeres*, to be considered later on. (The MSS. at this writing are complete.)

Their affinities, if there be any, with the *Caprimulgi*, the *Cypseli*, the *Trogones*, the *Trochili* and the *Pici* must also be quite remote. But this will not apply to the Kingfishers, and much less to certain other groups in various parts of the Old and New World, as the *Musophagidæ*, *Bucconidæ*, *Galbulidæ*, *Meropidæ*, *Momotidæ*, *Bucerotidæ*, *Upupidæ*, *Todidæ*, *Coracidæ*, *Rhamphastidæ*, *Capitonidæ* and perhaps some few others.

These several families seem to have a Cuckoo vein running all through them, strongly impressed in some cases, barely discernible in others. Indeed, these groups of birds seem to have arisen from some very ancient and once common stock, but by the extinction of numerous related types and groups of types that once filled the now many and various gaps among them, it has left in recent times the most puzzling collection of polymorphic forms that the systematist has to deal with throughout the entire range of ornithology. They have become diversified through all the factors that organic evolution brings to bear upon such plastic organizations as they represent.

In the opinion of a number of authoritative ornithotomists the nearest affines of the *Cuculidæ* are to be seen in the *Musophagidæ*. while the *Meropidæ* are also said to exhibit especially a number of cuculine affinities. Personally, I have never examined the skeleton in any of the *Musophagidæ;* but of certain *Meropidæ* we shall speak a little further along in another memoir now in preparation. One thing must be constantly borne in mind, and that is Cuckoos differ not a little in their osteology among themselves—take *Crotophaga* and *Geococcyx californianus* for instance—so that we meet with certain species of them that in their skeletons offer a greater number of characters that agree with the corresponding characters in forms of other groups than do others of this suborder. Apart from the *Alcyones*, we have in our United States avifauna no very near affines of the *Coccyges*.

Probably the weight of opinion would be thrown in favor of placing the *Cuculidæ* near the *Musophagidæ*, the Plantain-eaters

or Tourocos of Africa. It was Huxley's opinion, Fürbringer thinks so, and Garrod thought so, but we cannot follow the latter in placing the *Cuculidæ* and *Musophagidæ* together in with the Gallinaceous birds!

During the time I have been engaged upon the present memoir, Vols. i and ii of Sharpe's very valuable *Hand-List of Birds* has been presented to me by the trustees of the British Museum, and in the second volume of that work I find the author inserts the Cuckoos in the system in the following manner:[1] The Order COCCYGES (xxxi) is placed between the Order TROGONES (xxx) and the Order SCANSORES (xxxii), and is primarily divided into two sub-orders, namely Sub-Order I, *Musophagi*, and Sub-Order II, *Cuculi*.

The *Musophagi* is made to contain the family *Musophagidæ*, and this latter includes the genera *Turacus* (23 species); *Gallirex* (2 species); *Musophaga* (2 species); *Corythæola* (1 species); *Schizorhis* (5 species); and *Gymnoschizorhis* (2 species). The second sub-order or the CUCULI is made to contain but the single family the *Cuculidæ*, and this is divided into six (6) sub-families thus:

SUB-FAMILIES.	GENERA.	NO. OF SPECIES.
I. CUCULINÆ.	Coccystes	9 species.
	Pachycoccyx	2 "
	Calliechthrus	1 "
	Surniculus	3 "
	Hierrococcyx	7 "
	Cuculus	11 "
	Penthoceryx	1 "
	Cercococcyx	1 "
	Cacomantis	13 "
	Mesocalius	1 "
	Metallococcyx	1 "
	Chrysococcyx	3 "
	Chalcococcyx	15 "
	Heterococcyx	1 "
	Coccyzus	13 "
	Urodynamis	1 "
	Eudynamis	7 "
	Microdynamis	1 "
	Rhamphomantis	1 "
	Scythrops	1 "

[1] R. BOWDLER SHARPE, LL.D.: *A Hand-List of the Genera and Species of Birds*. [Nomenclator Avium tum fossilium tum viventium.] Vols. i, ii. London, 1900.

Sub-Families.	Genera.	No. of Species.
II. Centropodinæ.	Centropus	41 species.
III. Phœnicophainæ.	Saurothera	6 "
	Hyetornis	2 "
	Piaya	7 "
	Zanclostomus	1 "
	Taccocua	1 "
	Rhopodytes	7 "
	Rhinortha	1 "
	Phœnicophaës	1 "
	Rhamphococcyx	2 "
	Rhinococcyx	1 "
	Urococcyx	3 "
	Dryococcyx	1 "
	Ceuthmochares	3 "
	Dasylophus	1 "
	Lepidogrammus	1 "
	Coua	11 "
	Cochlothraustes	1 "
IV. Neomorphinæ.	Carpococcyx	3 "
	Neomorphus	5 "
	Geococcyx	2 "
	Morococcyx	1 "
V. Diplopterinæ.	Diplopterus	1 "
	Dromococcyx	2 "
VI. Crotophaginæ.	Crotophaga	3 "
	Guira	1 "

We therefore find in Sharpe's *Hand-List* that the family *Cuculidæ* is made to contain 45 genera of Cuckoos, and these 45 genera include no less than 161 species. This is a great many different kinds of Cuckoos, and to me it is the most significant index extant, indicating how little, how very little, we yet know of their morphology, and consequently how much guesswork there must essentially be in our attempts to classify them.

The writer is indebted to Mr. Lucas, of the U. S. National Museum, for the loan of a skeleton of a Jacamar (sp. ?), a *Diplopterus*, and a specimen of *Nyctiornis amictus* from Borneo—one of the *Meropidæ*. All of these I have examined in the present connection and compared them with skeletons of *Ceryle alcyon* and *Ceryle cabanisi*.

Unfortunately the skeleton of *Diplopterus* had been injured, but

a glance at it is sufficient to satisfy us that it stands, in so far as its osteology is concerned, almost directly between the *Centropodinæ* and the *Cuculinæ*. It will be seen from what has been shown above that this is at variance with Dr. Sharpe's opinion.

Beyond what I have hazarded in the concluding paragraphs of this memoir then, in the way of suggestions as to the probable affinity of some of the more typical Cuckoos with other birds, I would not at the present time make or express any more decided opinion. I feel that I ought to command a far wider knowledge of the morphology of the entire group and several of the now-supposed allied groups than I possess at this writing before doing so, or before that opinion would be of any value.

Explanation of Plates.

[All the figures in the Plates are from photographs made direct from the specimens by the author. Figs. 1 to 6 inclusive in Plate I are of natural size, the material being from the author's private collection. The figures of Plate II are all very slightly reduced, and all in the same proportion. The skull shown in Fig. 7 is in the author's cabinets, while all the others belong to the U. S. National Museum.]

Plate I.

Fig. 1. Right lateral view of the skull and lower mandible of *Geococcyx californianus*. Adult.

Fig. 2. Inferior or basal view of the skull of *Geococcyx californianus*. Adult. Different specimen from the one shown in Fig. 1.

Fig. 3. Superior view of the mandible of *Geococcyx californianus*. Adult. Belongs to the skull shown in Fig. 2 of this Plate.

Fig. 4. Ventral aspect of the pelvis of *Geococcyx californianus*. Adult. Belonged to the same individual that furnished the skull shown in Fig. 1 of this Plate. On this pelvis the coccygeal vertebræ and pygostyle are attached *in situ*.

Fig. 5. Superior aspect of the cranium of a subadult specimen of *Geococcyx californianus*, showing principally the frontal and parietal bones with the sutures between them. The bones of the face and other elements have been removed.

Fig. 6. External aspect of the left femur, fibula and tibio-tarsus of a subadult specimen of *Geococcyx californianus*, from the same individual that furnished the skull shown in Fig. 5. The femur is not placed *in situ*, its proximal end is resting on the shaft of the tibio-tarsus, and in this figure we see the epiphysis on the summit of the latter described in the text.

Plate II.

Fig. 7. Right lateral view of the skull and mandible of an adult specimen of the Yellow-billed Cuckoo (*Coccyzus americanus*).

Fig. 8. Right lateral view of the skull and detached mandible of an adult specimen of the Ani (*Crotophaga sulcirostris*). Spec. No. 61467 of the Coll. U. S. Nat. Museum.

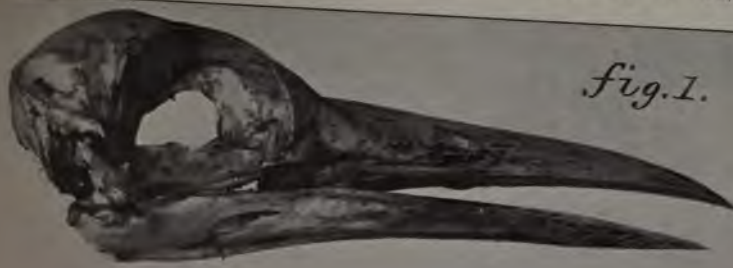

fig. 1.

fig. 2.

fig. 3.

fig. 4.

fig. 5.

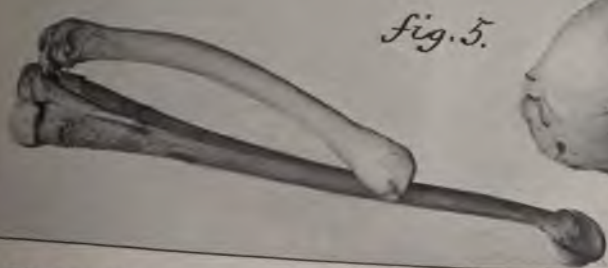

fig. 6.

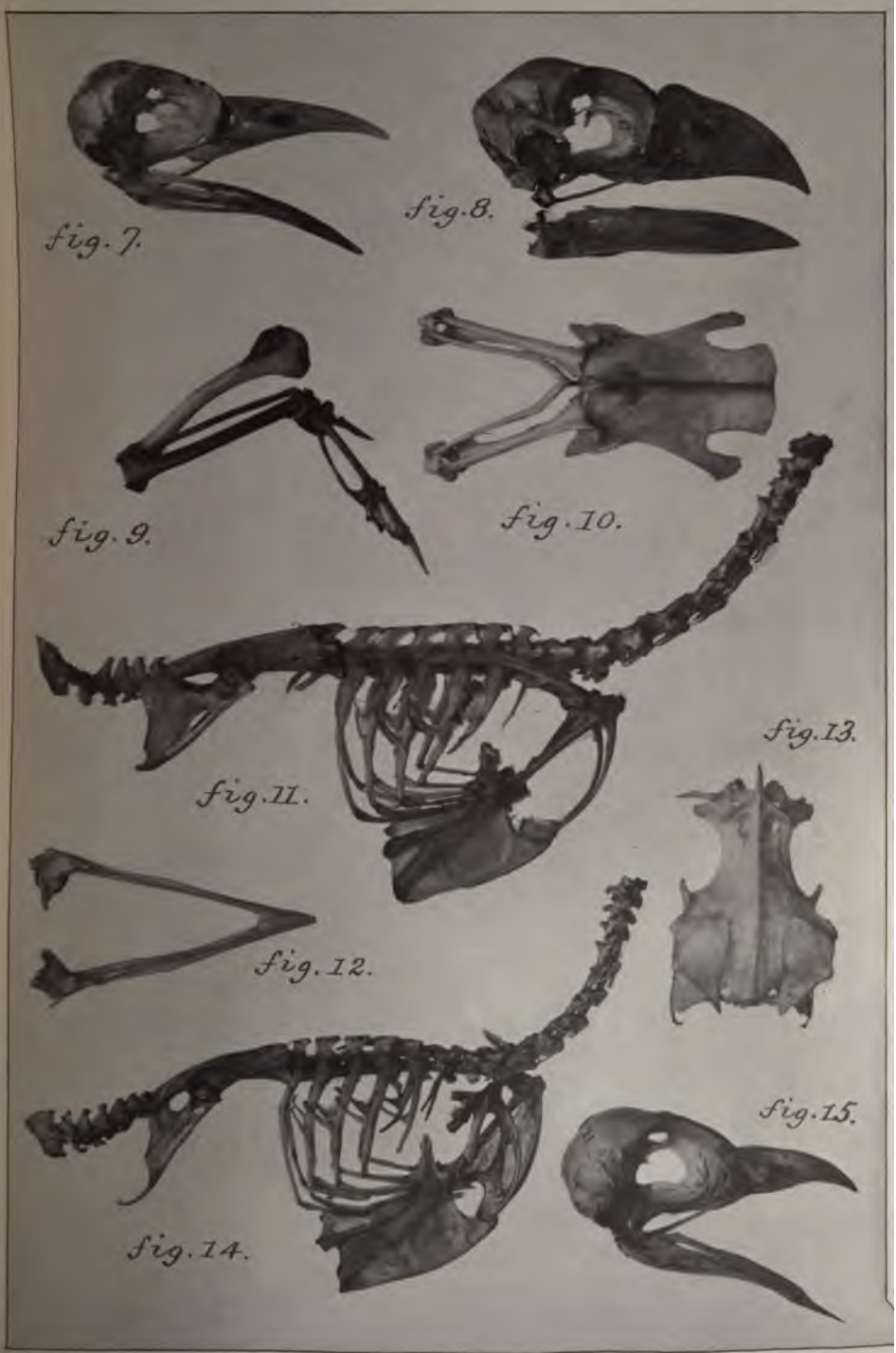
fig. 7.
fig. 8.
fig. 9.
fig. 10.
fig. 11.
fig. 12.
fig. 13.
fig. 14.
fig. 15.

FIG. 9. Outer view of the skeleton of the right pectoral limb of *Crotophaga sulcirostris*, from the same individual that furnished the skull and mandible shown in Fig. 8 of this Plate.

FIG. 10. Ventral aspect of the sternum, coracoids and os furcula of *Centropus superciliosus*. Adult specimen. (From Spec. No. 19112, Coll. U. S. Nat. Mus.)

FIG. 11. Right lateral aspect of the spinal column and the trunk skeleton of adult specimen of *Crotophaga sulcirostris*, from the same individual that furnished the skull shown in Fig. 8 and the pectoral limb shown in Fig. 9.

FIG. 12. Superior aspect of the lower mandible of *Centropus superciliosus*, from the same specimen that furnished the sternum shown in Fig. 10.

FIG. 13. Dorsal aspect of the pelvis of *Centropus superciliosus*, from the same individual that furnished the sternum shown in Fig. 10 and the lower jaw in Fig. 12 of this Plate.

FIG. 14. Right lateral aspect of the spinal column and the trunk skeleton of *Diplopterus nævius*. Adult. (Spec. No. 19,221, Coll. U. S. Nat. Mus.) The scapulæ have been broken off and there is a fracture of the right coracoid.

FIG. 15. Right lateral aspect of the skull and lower mandible of *Diplopterus nævius*. This skull is from the specimen that furnished the trunk skeleton shown in Fig. 14 of this Plate.

Stated Meeting, January 18, 1901.

J. CHESTON MORRIS in the Chair.

Present, 8 members.

The decease of Baron de Selys Longchamps, at Liège, Belgium, on December 11, 1900, at the age of 86, was announced.

Prof. Thomas H. Montgomery presented for the *Transactions* "A Study of the Chromosomes of the Germ Cells of Vortozoa."

Mr. Joseph Willcox called attention to some meteorological deceptions practiced upon box turtles in the vicinity of Philadelphia this winter.

Dr. I. Minis Hays was chosen Librarian for the ensuing year.

The following Standing Committees were appointed for the year:

Finance.—Philip C. Garrett, William V. McKean, Joel Cook.

Hall.—Joseph M. Wilson, Harold Goodwin, John Marshall.

Publication.—Henry Carey Baird, Patterson DuBois, I. Minis Hays, Joseph Willcox, Morris Jastrow, Jr.

Library.—George F. Barker, T. Hewson Bache, Albert H. Smyth, Joseph G. Rosengarten, Edwin G. Conklin.

Michaux Legacy. — Thomas Meehan, Angelo Heilprin, William Powell Wilson, Burnet Landreth, Joseph T. Rothrock.

The Society was adjourned by the presiding member.

Stated Meeting, February 1, 1901.

Vice-President SELLERS in the Chair.

Present, 21 members.

A notice of the Fiftieth Anniversary of the Imperial Royal Zoological and Botanical Society of Vienna, on March 30, 1901, was received with an invitation to send delegates to the same.

An invitation was received from the Provost and Vice-Chancellor of the University of Glasgow to send delegates to the Ninth Jubilee (450th Anniversary) of the founding of the University, to be held on June 12, 13 and 14 next.

On motion, these invitations were referred to the Officers and Council for action.

A communication was also received from the Academie Royale des Sciences de Turin announcing the offer of a prize of 9600 francs for the most brilliant or important discovery on physical or experimental science.

The death of Prof. Elisha Gray, at Newtonville, Mass., on January 21, 1901, was announced.

Vice-President Sellers delivered the Annual Address, taking for his subject "Technical Education."

The Society was adjourned by the presiding officer.

Stated Meeting February 15, 1901.

Vice-President Barker in the Chair.

Present, 27 members.

Mrs. Zelia Nuttall exhibited proofs of a *fac-simile* of the ancient Mexican Codex which she has recently brought to light. She described how she learned of the existence of this Codex; how it had once belonged to the Library of San Marco, in Florence, whence it was stolen and sold; and how she succeeded in tracing it and obtaining from its present owner, an English nobleman, the permission to publish it in *fac-simile*, and thus place it within the reach of the scientific world.

The costly reproduction of the Codex has been rendered possible by the generosity of Mr. Charles P. Bowditch, of Boston, a patron of the Peabody Museum of American Archæology and Ethnology, Cambridge, Mass., under whose auspices the publication will be shortly issued, with an introduction and notes by Mrs. Zelia Nuttall.

The original Codex is painted on a long, delicately prepared strip of deerskin, which is painted on both sides, is folded zizzag fashion and forms forty-four pages on one side and forty-three on the other, making a total of eighty-seven pages covered with pictography.

The Codex commemorates wars and victories and gives the names of a number of conquered towns and vanquished chieftains. It is a native historical document of unparalleled importance, and is, besides, the best preserved, most carefully executed specimen of Mexican pictography known, its artistic excellency being only comparable to that of the Vienna Codex. The latter, preserved at the Imperial Library at Vienna, appears, indeed, to be the work of the same native scribe. What is more, both Codices furnish internal evidence proving that they deal with the same period of native history and contain references to some of the same events and localities. The inference is that they belong together, complement each other, and were sent from Mexico to the Old World at the

same time. Mrs. Nuttall is inclined to think that these Codices may be identified with the "two native books" enumerated amongst the presents sent by Cortez to Charles II, and is investigating this point prior to the publication of the new Codex.

Mr. Stewart Culin presented a communication on "Some Results of a Recent Collecting Trip Among the American Indians," with an exhibition of many interesting specimens.

The Society proceeded to the election of members, and the tellers reported that the following-named candidates had been duly elected to membership in the Society:

Prof. Henry H. Giglioli, of Florence, Italy.
William M. Meigs, of Philadelphia, Pa.
Richard Garnett, of London, Eng.
George Harrison Fisher, of Philadelphia, Pa.
Prof. Josiah H. Penniman, of Philadelphia, Pa.
Prof. H. C. Bumpus, of Providence, R. I.
John T. Morris, of Philadelphia, Pa.
Dr. Simon Flexner, of Philadelphia, Pa.
Giovanni Schiaparelli, of Milan, Italy.
Prof. Oliver Joseph Lodge, of Birmingham, Eng.
Guglielmo Marconi, of Dorset, Eng.
Charles Francis Adams, of Boston, Mass.
Prof. Wladimir Markownikoff, of Moscow, Russia.

The Society was adjourned by the presiding officer.

Stated Meeting, March 1, 1901.

Curator LYMAN in the Chair.

Present, 10 members.

Mr. John T. Morris, a newly elected member, was presented to the Chair and took his seat in the Society.

Letters accepting membership were received from Prof. Josiah W. Penniman, Mr. Charles Francis Adams, Mr. John T. Morris and Mr. William M. Meigs.

The President announced the appointment of Prof. Edward Suess, of Vienna, to represent the Society at the jubliee celebration of the K. K. Zoologisch-Botanische Gesellschaft, to be held at Vienna on March 30.

The list of donations to the Library was laid on the table and thanks were ordered therefor.

Dr. R. W. Shufeldt presented for the *Transactions* a memoir on "The Osteology of the Steganopodes."

The Society was adjourned by the presiding officer.

Stated Meeting, March 15, 1901.

Vice-President WISTAR in the Chair.

Present, 25 members.

Prof. Jacques Loeb, Prof. Arthur S. Mackenzie and Prof. Josiah H. Penniman, recently elected members, were presented to the Chair and took their seats in the Society.

Letters were received from Mr. Richard Garnett, of London, and Prof. Oliver Joseph Lodge, of Birmingham, Eng., accepting membership.

The President announced the appointment of the Hon. Charlemagne Tower and Prof. Albert H. Smyth as delegates to the ninth jubilee celebration of the University of Glasgow.

An invitation to send delegates was received from the President of the Fifth International Congress of Zoölogy, to be held at Berlin, on August 12–16, 1901.

Prof. Jacques Loeb, of the University of Chicago, read a paper on "Artificial Parthenogenesis," which was discussed by Prof. Conklin.

The Society was adjourned by the presiding officer.

Stated Meeting, April 12, 1901.

Vice-President BARKER in the Chair.

Present, 25 members.

Letters were read: From Mr. Guglielmo Marconi, Prof. Henry H. Giglioli and Dr. Simon Flexner, accepting membership.

From the K. K. Zoölogisch-Botanische Gesellschaft in Wien, containing an invitation to a banquet on the 30th of March, in honor of the 50th anniversary of the founding of the Society.

From Prof. Edward Suess, of Vienna, announcing that he had discharged the duty which he had been appointed by this Society to perform as its delegate to the K. K. Zoölogisch-Botanische Gesellschaft in Wien, and had transmitted the congratulatory address which this Society had forwarded.

From Hon. Charlemange Tower, accepting the appointment as one of the Society's delegates to the approaching 450th anniversary celebration of the founding of the University of Glasgow.

A list of donations to the Library was laid on the table and thanks were ordered for them.

Dr. Horace Howard Furness presented on behalf of the donors a portrait of the late Dr. William Pepper.

The thanks of the Society were tendered to the donors for their valued gift.

The death was announced of Lorin Blodgett, Esq., in Philadelphia, on March 24th, aged 79 years.

Mr. R. H. Mathews presented a paper on "Aboriginal Rock Pictures in Queensland," upon which remarks were made by Gen. Wistar and Mr. Culin.

The meeting was adjourned by the presiding officer.

ABORIGINAL ROCK PICTURES IN QUEENSLAND.

BY R. H. MATHEWS, L.S.

(*Read April 12, 1901.*)

A number of interesting aboriginal carvings are found on the Burnett river, parish of South Kolan, county of Cook, in the State of Queensland. The drawings are cut upon some flat rocks situated in the wide channel of the river mentioned, at the junction therewith of Pine creek, this point being a little over fourteen miles in a direct line southwesterly from Bundaberg, an important town on the Burnett river. The small township of South Kolan is situated about four miles northwesterly from these carvings, and is the nearest railway station from which they can be reached. The Burnett river, in this locality, consists of a series of large water-holes, between which the stream runs in narrow channels worn in the rocky bed.

The rocks containing the carvings are a kind of hard sandstone, which during the greater part of the year are quite dry, but in times of floods are wholly submerged. Owing to the latter circumstance, and long exposure to the weather, many of the drawings are now scarcely distinguishable. Most of the figures are small, varying from a few inches in length to upward of two feet, representing native weapons, animals, human feet, and several nondescript devices. The outline of each figure is defined by a groove cut into the hard surface of the rock to a depth varying from one-eighth to one-quarter of an inch, the width of the groove ranging from less than half an inch in the smallest to about an inch and a quarter in the largest specimens.

The mode of execution was to make a row of indentations or punctures along the outline of the drawing by means of repeated blows with sharp-pointed pieces of hard stone. The distance between the indentations varies from about a third of an inch to half an inch or more, being farther apart in the larger objects. The space between each puncture was subsequently chipped out, thus making a complete groove around the exterior of the drawing. The positions of the punctures are still discernible, being somewhat deeper and wider than the other portions of the groove—remaining as a

witness of the method adopted by the artist in carrying out the work.

Old residents of the district have known of these rock carvings for twenty-five or thirty years, which were then fresher and more numerous than at present. Very little notice was, however, taken of them, and so far as I am aware, no definite description of them has hitherto been published.

Near Rawbelle, a stock station on the Rawbelle river, one of the headwaters of the Burnett river, county of Wicklow, Queensland, similar carvings to the foregoing have been observed. They are cut on some large rocks on the sides and bed of a watercourse about four miles distant from Rawbelle head station in a westerly direction. The carvings comprise human figures, weapons, feet of men and animals, and several indecipherable representations. The rock on which they are incised is a dark hard sandstone, and the method of procedure in executing the drawings is the same as that described in dealing with the carvings near South Kolan. Some of the pioneers of this part of Queensland have known of these drawings for thirty or forty years, but no attention has been given to them.

About two miles in a northwesterly direction from Augustus Downs' cattle station, on the bank of the Leichhardt river, in northern Queensland, is a large rock containing aboriginal carvings, among which may be mentioned representations of boomerangs of different shapes, shields, and one or two human hands. The rock, which is a kind of conglomerate, is gradually crumbling away under exposure to the weather and from other causes, owing to which some of the native drawings have disappeared since they were first observed some years ago.

Stated Meeting, April 19, 1901.

Vice-President SELLERS in the Chair.

Present, 19 members.

The donations to the Library were laid on the table, and thanks were ordered for them.

The decease was announced of the following members:

Prof. Henry A. Rowland, at Baltimore, on April 16, 1901.

Rev. Dr. F. A. Muhlenberg, at Reading, on March 21, 1901, aged 82.

Prof. W. B. Scott presented a paper on "The Miocene Faunas of Patagonia," which was discussed by Gen. Wistar, Prof. Pilsbry, Prof. Conklin, Dr. Sellers and Mr. Balch.

Dr. Morris Longstreth exhibited a specimen of the so-called blood-rain which recently fell in Italy.

The meeting was adjourned by the presiding officer.

MAGELLANIC PREMIUM.

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1901.

THE AMERICAN PHILOSOPHICAL SOCIETY,

Held at Philadelphia, for Promoting Useful Knowledge

ANNOUNCES THAT IN

DECEMBER, 1901,

IT WILL AWARD ITS

MAGELLANIC GOLD MEDAL

to the author of the best discovery, or most useful invention, relating to Navigation, Astronomy, or Natural Philosophy (mere natural history only excepted) under the following conditions:

1. The candidate shall, on or before November 1, 1901 deliver, free of postage or other charges, his discovery, invention or improvement, addressed to the President of the American Philosophical Society, No. 104 South Fifth Street, Philadelphia, U. S. A., and shall distinguish his performance by some motto, device, or other signature. With his discovery, invention, or improvement, he shall also send a sealed letter containing the same motto, device, or signature, and subscribed with the real name and place of residence of the author.

2. Persons of any nation, sect or denomination whatever, shall be admitted as candidates for this premium.

3. No discovery, invention or improvement shall be entitled to this premium, which hath been already published, or for which the author hath been publicly rewarded elsewhere.

4. The candidate shall communicate his discovery, invention or improvement, either in the English, French, German, or Latin language.

5. A full account of the crowned subject shall be published by the Society, as soon as may be after the adjudication, either in a separate publication, or in the next succeeding volume of their Transactions, or in both.

6. The premium shall consist of an oval plate of solid standard gold of the value of ten guineas, suitably inscribed, with the seal of the Society annexed to the medal by a ribbon.

All correspondence in relation hereto should be addressed

TO THE SECRETARIES OF THE

AMERICAN PHILOSOPHICAL SOCIETY,

NO. 104 SOUTH FIFTH STREET,

PHILADELPHIA, U. S. A.

PROCEEDINGS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY

HELD AT PHILADELPHIA FOR PROMOTING USEFUL KNOWLEDGE.

VOL. XL. JULY, 1901. No. 166

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PHILADELPHIA:

THE AMERICAN PHILOSOPHICAL SOCIETY,

104 South Fifth Street.

1901.

It is requested that all correspondence be addressed

To the Secretaries of the

AMERICAN PHILOSOPHICAL SOCIETY,

104 South Fifth Street,

Philadelphia, U. S. A.

Members will please communicate to the Secretaries any inaccuracy in name or address as given on the wrapper of this number.

It is requested that the receipt of this number of the Proceedings be acknowledged to the Secretaries.

Members who have not as yet sent their photographs to the Society will confer a favor by so doing; cabinet size preferred.

PROCEEDINGS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY

HELD AT PHILADELPHIA FOR PROMOTING USEFUL KNOWLEDGE.

VOL. XL. JULY, 1901. No. 166.

Stated Meeting, May 3, 1901.

Vice-President WISTAR in the Chair.

Present, 13 members.

Letters were read as follows:

From Prof. Vladimir Marcovnikoff, accepting membership.

From K. K. Zoologisch-Botanische Gesellschaft, expressing sincere thanks for the honor shown by the transmission of the congratulatory address on the occasion of its fiftieth anniversary celebration.

From Institute of Jamaica, thanking the Society for continuing to send its *Proceedings*, notwithstanding the temporary suspension of the publications of the Institute.

The donations to the Library were laid on the table, and thanks were ordered for them.

The decease of the Right Reverend William Stubbs, Lord Bishop of Oxford, on April 22, 1901, at the age of 75, was announced.

Prof. Lewis M. Haupt made some remarks on "Methods of Deepening Ocean Bars," which was discussed by Gen. Wistar.

Mr. R. H. Mathews presented a paper on "The Thoorga and Other Languages."

Prof. W. B. Scott presented for the *Transactions* a paper on "The Fossil Mammalia of the White River Beds of Montana," by Mr. Earl Douglass.

The meeting was adjourned by the presiding officer.

PROC. AMER. PHILOS. SOC. XL. 166. E. PRINTED JUNE 26, 1901.

METHODS OF IMPROVING OCEAN BARS.

BY LEWIS M. HAUPT.

(*Read May 3, 1901.*)

In an official report on the "Brunswick Outer Bar, Georgia,"[1] the U. S. Engineer now in charge of that work presents an elaborate analysis of five methods available for creating navigable channels: (*a*) by the use of dynamite; (*b*) by a single jetty; (*c*) by a single curved breakwater; (*d*) by twin jetties; and (*e*) by dredging; from which he concludes that the last is "probably" the most economical and hence he recommends that "the Government should own and operate such sea-going dredges as are necessary and not call upon contractors for such work at all."

Inasmuch as the history of maritime works is replete with the failure of dredging machines to create and maintain deep channels in the open ocean and that the analysis and conclusions as to the methods are so erroneous as to facts and results, the writer feels impelled, in the interest of the public service, to submit a brief review of some of the cases cited therein, with a view of bringing out the truth more clearly.

1. DYNAMITE.

On this subject the author of the report, although having had no experience in the use of dynamite, concludes as follows:

"Fourth. The channel produced (at Brunswick, by use of dynamite) has no advantage of permanence over a dredged channel of similar size and location, which could be produced for about one-twelfth of the cost of the present channel." The unfortunate part of this comparison and assertion is that the "channel produced" is the result of dynamite aided by dredging, and is not therefore such a channel as might have been secured by dredging alone, for it is a curved channel with flat slopes constructed by aid of natural forces and which is larger than the channel contracted for and unusually permanent. None of these things would be true of a dredged channel in the open sea, unprotected by jetties or regulating works. As no dredged channel of similar size and *location* exists as a basis, no comparison can be made as to cost at this site; but a thorough analysis of other efforts to secure deep channels elsewhere shows that this effort of the contractor has been far less expensive, both for

[1] See Document 355 H. R., 56th Congress, 2d Session.

construction and maintenance, than any or all other methods attempted by the Government, as the accompanying statement, compiled from official statistics, will attest. An inspection of this exhibit will show that the cost per foot of depth gained at six other ocean bars ranged from $166,000 to $893,000, the average being $468,560, so that the cost at Brunswick is only about *ten per cent.* of that at other points where large annual expenses are still required for maintenance.

The work at Brunswick was undertaken by a private citizen of that place, at his own risk and expense, under contract with the Government for payments only after the results were secured, in order to save the commerce from annihilation. The officer in charge states that to build there a pair of "high tide jetties which might be expected to create and maintain an ample channel would be prohibitory. Jetties to low tide could be expected merely to preserve the channel location and reduce the cost of dredging. The estimated cost of these is $2,829,608. The interest on this sum at three per cent. would be $84,888.24 per annum, or probably much more than enough to create annually, by dredging, the channel depths and widths required by the act."

In a subsequent part of his report the officer in charge estimates that the requisite channel could have been created by removing 125,000 cubic yards at a cost of only $18,750. It may well be asked why this discovery was not made and applied at an earlier date and the $253,646 already paid the contractor for his channel, secured after seven years of labor, have been saved.

While this conclusion leaves the whole matter of cost problematical and guarantees nothing, it also assumes that low tide jetties would fix the channel and reduce the cost of dredging, whereas the result would be to admit and impound the littoral drift between them and so increase the amount to be removed if it did not entirely obliterate the channel, as has happened at Cumberland Sound, immediately to the south, where this plan was tried by his predecessor and signally failed. But if the cost of maintenance were even as low as $60,000, this at three per cent. would represent $2,000,000, and the single reaction breakwater could be built on this bar for less than half this sum, which would create and maintain the channel; but the author of the report dismisses this method with the remark that its theory is "fatally defective," and further that the breakwater at Aransas Pass built on this plan "is not located according to

COMPARATIVE STATEMENT SHOWING COST OF OUTER BAR DEEPENING PER FOOT UPON OCEAN BARS ON THE GULF AND ATLANTIC COASTS AS COMPARED WITH SUCH COST AT BRUNSWICK, GEORGIA, PORTS BEING TAKEN FOR COMPARISON WHICH ARE STRICTLY OCEAN BAR, AND NOT AS AT SAVANNAH AND MOBILE, WHICH ARE MAINLY RIVER IMPROVEMENTS; ALSO COMPARATIVE COST PER FOOT, WITH COST ESTIMATED BY THE GOVERNMENT FOR THE OUTER BAR OF BRUNSWICK, GEORGIA.

NAME OF OCEAN BAR.	Estimate of cost per foot by the Chief of Engineers approving Carter's recommendation.	Actual cost per foot of depths obtained.	Total of appropriations for the improvement.	Total estimated for the entire improvement by Chief of Engineers.	Total commerce of each port for 1897, as shown by Chief of Engineers' Report for 1898.	Number of feet of depth estimated for by Carter or engineers.	Number of feet of depth procured and for Brunswick certified.	Time work has continued on bar—years.	AUTHORITIES REFERRED TO. Chief of Engineers' Reports and R. and H. Acts.	REMARKS.
Brunswick, Ga. . .	$339,750	$45,293	$253,646	$2,718,000	$18,385,224	8	5.6	7	Special Report O. M. Carter to 51st Congress; R. and H. Acts, 1894–'6; Report Chief of Engineers, 1898, p. 1317.	The average cost per foot at the six ports other than Brunswick is $468,560, or more than twice as much for one foot as is appropriated conditionally for seven feet at Brunswick, or, if paid for at same rate per foot, it would make the seven feet at Brunswick cost $3,279,920. The commerce of Brunswick for 1898 is $21,433,317, and has risen by steady increases from 1895, when it was $12,295,967, all due to increased draught of water on the bar.
Galveston		652,177	8,478,300		94,596,293	18	13	28	Chief of Engineers' Report, 1898, p. 1493.	
Sabine Pass		166,375	2,994,750		2,362,542	18	18	23	Chief of Engineers' Report, 1898, p. 1482; 1896, p. 1512.	
Pensacola			650 000		8,649,532			20	Chief of Engineers' Report, 1898, p. 1397; 1896, p. 1375.	The reliance at Pensacola is upon dredging, which has been done at charges ranging from 79 cents to 10 cents per cubic yard. The engineers' reports referred to show that depths obtained by *dredging have closed up again each time after dredging*.

Charleston.		508,009	4,064,079		12,106,763	8	8	19	Chief of Engineers' Report, 1888, p. 970; 1889, p. 1150; 1896, p. 1189; 1898, p. 1283.	The statement of commerce for Charleston probably excludes domestic imports and exports, and this may also be true at Pensacola. The statement at other ports of commerce is of imports and exports, foreign and domestic. If so, Charleston's commerce should probably be much larger. In 1896 the reported value of exports and imports, foreign and domestic, were $70,247,003. There has probably been a falling off, but not so great as figures given indicate.
Winyaw Bay. . . .		377,050	2,428,749		5,817,950	8	3	12	Chief of Engineers' Report, 1885, p. 1164; 1889, p. 1114; 1894, p. 1059; 1895, p. 1349; 1896, p. 1165; 1898, p. 1272; R. and H. Acts, 1896.	
Mouth St. Johns River, Fla. . . .		214,000	1,617,000		9,089,150	9	7	18	Chief of Engineers' Report, 1896, p. 1305; 1898, p. 1327.	
Fernandina or Cumberland entrance.		893,750	3,307,500		7,942,192	8	2	18	Chief of Engineers' Report, 1898, p. 1323; 1896, p. 1289; R. and H. Acts, 1896.	The channel sought by construction of jetties, between the jetties, does not exist at all. A large portion of the area between jetties is bare at low water. The only channel to sea is broken directly through the south jetty, and the two feet of increased depth is there only a part of the time.

the theory," although admitting that beneficial results have followed its construction. In the large space which he devotes to its discussion, he unwittingly shows that the theory and its application are entirely misunderstood by himself and others who have attempted to apply it at other places, and that great waste to the Government has resulted from a misconception of local physical conditions.

2. The Single Jetty.

It is generally believed that to protect an area from material moving in a given direction it is necessary to place a barrier on the near side of the area, or *between it and the source of the drift,* to arrest it on the "windward" side. This is the common practice on our western prairies to defend the railroads from prevailing winds and snowdrifts, or along our seashore drives to keep the sand out. To place the barricade on the far side would result in rendering such thoroughfares impassable or greatly increase the cost of maintaining traffic. Precisely the same laws obtain in sand driven by ocean currents or waves, and yet it appears that almost invariably and with numerous precedents as a guide the jetty is placed on the *far* or wrong side of the channel to be created, where it invariably chokes it up and results in pushing the bar seaward, giving no beneficial result from the natural energy and adding greatly to the cost.

For example, this report says that a single jetty projecting from shore to fix the channel and prevent a considerable escape of the tidal flow should be placed on the *leeward* of the channel, or "upon that side of the channel toward which the latter is being driven by the drifting sands," and it adds, "This principle of construction was first suggested by Major Thomas W. Symons, Corps of Engineers, U. S. Army."

The Major will hardly claim the honor of so serious a fallacy, since a jetty so located was suggested by a former Chief of Engineers, now deceased, for the improvement of *Aransas Pass* and was partially built by the district engineer in the years 1885–90, but it merely intercepted the littoral drift moving southerly, dropped it in the channel which it obstructed and pushed the bar seaward with a consequent loss of depth. It cost nearly half a million dollars and was an acknowledged failure. It furnished a complete demonstration of the falsity of the theory of attempting to create a channel by placing a jetty to "leeward of the channel."

This experience should have sufficed, but it did not, as the same error was repeated at *Galveston*, where for many years an effort was made to create a channel by building one jetty on the "leeward" side of the channel which it closed by a shoal, and which rolled the crest of the bar about three miles farther into the Gulf and with no increase of depth. It was only after the windward jetty was built which partially arrested the drift that dredges were enabled to make any material impression on the depth.

In this single instance, the repetition of this error in the order of construction has increased the cost of the work more than $6,000,000, and yet, notwithstanding the frequent discussions of this subject, it does not seem to have been sufficient to have been convincing, since it is again seriously recommended to repeat the mistake by locations made on the "leeward" side of the channel, and the success which has attended the opposite location is pronounced "fatally defective."

Moreover, it is true that several jetties have been partially constructed on the Pacific coast also based upon this erroneous idea, that the best way to create a channel was, first, to dam it up by a jetty to leeward and then to dredge it out, as the sequel will show.

The report says (p. 19), "A single jetty at *Coos Bay*, Oregon, has been built in accordance with this theory and appears to have been successful in increasing the depth from ten feet to not less than eighteen feet, which latter it has maintained for the last five years."

Unfortunately for this alleged increase of eight feet, caused by a jetty built to leeward, upon which reliance is placed to prove the theory, the official records of the Reports of the Chief of Engineers show that the natural depths prior to the beginning of the work were at one time twenty-seven feet,[1] while the latest report gives the depth as ranging from eighteen to twenty-two feet and the map shows the limiting depth to be nineteen feet, or a loss of eight feet instead of a gain, thus disproving the theory of the leeward jetty, as in

[1] See Report, 1892, p. 2673: "Capt. Magee states that the best water and safest channel is always found when the channel across the bar is in its most southern position, *i. e.*, about 500 or 100 feet south of the present position of the bar buoy. It is safest because it affords the shortest and most direct route to the sea, and enables a vessel generally to take the swell head on, or nearly so. At one time when the channel was in the above position there were twenty-seven feet at low water across the bar."

other cases. This single jetty is, however, but the incompleted part of a twin jetty project and hence was not designed to operate as a single reaction jetty at all. The total appropriations were $888,750, while the estimated amount to complete the twin jetties to secure twenty feet is $1,791,412.20; total, $2,680,162.20. The bar is moving seaward at a more rapid rate than ever, and is now about 1800 feet beyond the jetty. Its average rate is 200 feet per annum.

The question may well be asked, Why build this second jetty, at so great cost, if the depths are already over twenty feet, and if dredging is so much cheaper? The map however shows why, since a sand spit extends from the southerly side of the channel to beyond the end of the north jetty and the bar is 1800 feet beyond the end of the work. The crossing is north of the jetty which extends straight out from high water mark. In the writer's opinion, had the south jetty been built first the north one could have been greatly shortened, or possibly omitted altogether.

The low tide jetty at the mouth of the *Columbia river,* to which reference is made, although placed on the windward side of the channel with reference to the littoral drift, was not built high enough to intercept that movement, neither was it curved in the right direction to control the ebb reaction, and hence it followed that during the time while the groin was filling the bar deepened, but as soon as this was accomplished and the drift could travel over it, the bar again retrograded and a further extension of over four miles is required to catch up with the advancing bar. This jetty has cost $1,965,022.76.

The last annual report (1900) says, "The result of the survey shows a decrease in depth of from four to five feet at mean low water. The greatest depth reported the previous year was twenty-eight feet. . . . . Rapid extensions of the jetty seem essential to recovering former depths." The map shows twenty-three feet on the bar.[1] The estimate for forty feet is placed at $2,531,140. It is not an illustration, however, of a jetty placed to leeward of the channel, neither is it a correct application of one to windward, as it violates the conditions of protecting the channel from the drift and of conserving the energy of the effluent stream.

Failure fully to comprehend the lessons furnished by the precedents referred to in this report results in a repetition of the

[1] Natural depths of twenty-eight feet were reported prior to 1850. *Vide* Wilkes' *Western America,* 1849, Library of Congress.

unwise recommendation that "A single jetty on this principle at Brunswick would be located on the south side of the channel, since the drifting sands come from the north."

Such a location, if followed, would in the writer's opinion be ruinous to the commerce of that port. Its estimated cost is $1,517,798.

It is certain that it would dam up the channel and push the bar to the sea with the same or less depth than previously existed, as happened to the Government plans at Aransas Pass and Galveston during construction, also at *Cumberland Sound* where the south jetty, projecting to leeward, has entirely obliterated the old channel and made it necessary to open a new one by dredging away a part of that jetty and opening a passage to a new crossing under its lee. This experiment, as shown in Senate Document No. 163, Fifty-fifth Congress, First Session, should have sufficed to illustrate completely the results to be anticipated from such a proposition for Brunswick, where, it is stated, there "is an enormous sandbank which moves and which always moves very positively in one direction."

So pronounced was the failure at Cumberland Sound, after twenty years of study and experiment and the appropriation of $1,787,500, that in 1897 Congress called for a report to ascertain whether an emergency appropriation should not be made "to protect the entrance from being closed against commerce." In the report made in pursuance of the resolution, the officer then in charge stated: "The navigable bar channel has deserted the desired route entirely, the present channel crossing the south jetty about 7000 feet seaward of its initial point." Also the bar crossing is now "nearly half a mile south of the outer end of the jetty" and the "least depths are somewhat less than thirteen feet." This was the natural depth. The comparative maps in this report show that instead of the channel remaining in its original position as it should have done, according to the theory of the author, it was actually driven across the intercepting jetty and sought its normal position along the line of least resistance in its lee, thus bringing the jetty to windward, where it should have been placed at first.

Thus Nature would teach Science, if the latter would but learn to interpret her results correctly. A more complete illustration can hardly be found of the soundness of the theory of interposing the

barrier between the channel and the advancing drift, or to windward and not to leeward. Here where a jetty was built to leeward, according to the author's ideas, the natural forces changed it to windward by shifting the channel to the opposite side—a complete demonstration in his own district.

The report also shows that a deep and narrow channel is anticipated on the windward side of the jetty, for it says:

"It is difficult to see how such a constant force from the north could avoid crowding the channel close to the jetty and making it sufficiently deep near the latter torequire extensive and expensive work to prevent undermining."

The results, however, are just the reverse of this as seen at Cumberland Sound, for the sand being heavier than water, when it meets with an obstruction is dropped in the channel, if to windward, and fills it up. Yet notwithstanding these years of experience and expense at Cumberland the report states: "The jetties so far constructed at Cumberland Sound have not yet progressed sufficiently far to have much influence upon the bar depths."

On the contrary, the author might have said with more truth, they have had so great an influence upon the bar depths as to have entirely obliterated the old channel, and to have created a new one which now crosses the south jetty through the breach made to admit light draught vessels to the port. The depth has not been increased.

A somewhat similar experience occurred at Manasquan inlet on the New Jersey coast, where the jetties were completely buried under a sand bank and appropriations were requested to remove the obstructions. These lessons of experience are lost upon a constantly shifting personnel and they have cost the Government much time and money, whereas the bar depths have not been materially increased by the application of natural forces. In recent years, by localizing the channel at the mouth of the Columbia, there was a temporary gain of about four feet at a cost of $500,000 per foot; and at Galveston of thirteen feet, mainly by dredging, costing nearly $700,000 per foot to date. The total expenditures by the Government on its works at Aransas Pass, Galveston, Coos Bay, Columbia Bar, Cumberland Sound, St. John's River and Gray's Harbor, where in most cases the leeward jetty was built first with injurious results, have been about seventeen millions of dollars ($17,000,000) and still the same method is urged as being the proper policy to pursue.

3. "The Single, Curved Breakwater."

The report next analyzes the reaction breakwater partially built by private capital at Aransas Pass, stating some of the requirements it was designed by its inventor to fulfill, namely: (1) It must be located on the windward side of the channel. (2) It must be detached from the shore to admit the full tidal prism. (3) It must produce a continuous reaction across the bar by its curved trace.

Another requirement, which the author professes not to understand clearly, is that "the breakwater has to be curved to produce reactions similar to those found in the concavities of streams and having radii sufficient to maintain channels of the requisite depths;" also "the breakwater must change the conditions of equilibrium of flood and ebb currents in favor of the latter."

This last, he adds, "is too vaguely stated to admit of discussion." After stating that the first and second of the above requirements are directly contrary to each other, the author proceeds to predict what should happen, but which, unfortunately for his forecast, after some four years of exposure, has not happened. The channel has not shifted its position, there has been no dredging, nor any expenditure upon any part of the work for maintenance, and the depths have increased in the lee of the breakwater to a maximum of twenty-five and a quarter feet and a minimum of fifteen and a half feet, although large gaps were left in the breakwater at both ends when the work was suspended in 1897.

The sophistries and opinions suggested to discredit these unprecedented results are best answered by the results themselves, as the report acknowledges "at Aransas Pass to-day there is probably a minimum depth of fifteen feet with over twenty feet close to the jetty." This is therefore the admitted result, with barely half of the work contemplated in place.

The author next proceeds to show that not only is the theory defective, but that it has not been correctly applied; and to sustain this assumption he must, perforce, invert the direction of the littoral drift, ignoring entirely the former Government experience when the old curved jetty was built on the other side of the channel, and resulted in failure.

After concluding that the reaction breakwater is not built in accordance with the theory of its designer, the author then attempts to build up a case of two jetties by statements such as these:

"It seems plain that most of the operation is that simply of two

jetties, one somewhat longer than the other, its curved shape possibly making up in part for the lack of length in its mate. The first of these jetties—the north one—is composed of two parts, one of which is a natural bank extending from St. Joseph's Island to the inner end of the breakwater, a distance of about 1700 feet." As there is no "natural bank" across this 1700 feet of tidal opening, where the depths are from five and a quarter to four and three-quarters and two feet at mean low water and which opening is a part of the design to admit the full tidal enegry, and as all of the inner end of the so-called jetty to a point 4000 feet from the island is below water surface, some of it as much as fifteen feet, it is difficult to accept the statement that it is part of the jetty relied upon to control effectively the ebb currents or even to arrest sand, which does undoubtedly enter the channel through the gaps to the detriment of the work (see PROCEEDINGS OF AMERICAN PHILOSOPHICAL SOCIETY, Vol. 38, Plate VII).

But the author, not appreciating fully the important function of arresting this drift, adds that "the trend of the currents is such that no artificial structure is needed here." Yet the Government Board recommends in its proposed plan to close this opening by a sill some three or more feet high. Why should it do so if not needed to control the currents, or if, as the author asserts, the sand is drifting in through this opening, why should it not be needed to arrest this movement?

The report then stated that "for a further distance east of 4650 feet we have in the breakwater itself a more or less complete actual jetty, with a little foundation beyond this."

How much is "more" and how much "less" does not appear; so that from the author's view it would seem the north jetty consists of a natural bank for 1700 feet and a more or less completed actual jetty of 4650 feet, a total structure of 6350 feet, giving the impression to one ignorant of the facts that there is a retaining wall of that length which controls the currents, whereas of the reaction breakwater, or so-called "north jetty," less than 1500 feet reach above high water, and hence for only about twenty per cent. of this entire distance are the currents under the full control of the structure.

The alleged south jetty, according to the report, is built up in a similarly ideal manner, as follows:

"Opposing this and forming the south jetty we have, first, the reveted head of Mustang Island and the old Nelson jetty, extend-

ing from the same base to a distance of about 3150 feet. Beyond that we have the old Government jetty, a submerged structure, but still a jetty capable of exercising an important influence on the tidal flow a further distance of 2350 feet, making a north jetty having a total length of 6350 feet and a south jetty having a total length of 5500 and located about 1250 feet apart."

Again, to a novice these statements are grossly misleading, since the old Nelson jetty, which was built of wooden cylinders filled with sand, was destroyed where exposed to the sea soon after it was placed, as was predicted. It long since ceased to act as a jetty (see map, Fig. 6, in the report). There has been no revetment placed on Mustang Island for more than a decade, and its outer shore line has apparently advanced between January, 1899, and May, 1900, only about 500 feet; but this was *after* the depths as reported were secured (see Maps 5 and 6), and hence could not have been instrumental in causing them. Moreover, the old Government jetty is not only "submerged" but subterranean, being buried under the sand which the reaction breakwater has thrown over it; and hence being in a region of deposit, not of scour, and being under ground, it cannot be regarded as "capable of exercising an important influence on the tidal flow" as an active agent to confine the currents, and thus the fallacy of the two jetties 1250 feet apart is reduced to the effective portion of about 1500 feet of the breakwater extending above high water and the unfinished submerged flank of the same, partially overlapping the outer end of Mustang Island, but having gaps of fifteen feet and less in depth. The sand-bank on the southerly side of the channel is the dump for the material removed by the breakwater, and is the effect, not the cause, of the deepening created by it. The theory that these results are due to two jetties is wholly without foundation in fact.

Another serious error into which the author has fallen is in determining the direction of the resultant drift, which furnishes the key to the correct solution of the problem by a single jetty. He insists that all the charts which were accessible, as well as the statements of more or less interested parties, were to the effect that the resultant movement was from south to north, and that since the breakwater is on the north side it is therefore located to leeward and not to windward, as it should be according to the theory of the writer. He discusses the anemometer records, and although they show that the intensity of the northeast storms is to that of the southeast as 43.7 is

to 34.2, yet because the lighter winds prevail longer from the southeast he concludes that they are the determining factors, and overlooks entirely the unmistakable record of the movements of the inlets along this coast, as shown so clearly by the comparative charts which he must have consulted in the reports to which reference is made. These show that the tall masonry lighthouse built at Aransas Pass between 1851 and 1860, and which then stood abreast of the inlet to light the channel and bar crossing, is now about two miles to the north of the present position of the inlet and its bar, so that St. Joseph's Island has been extending southward at the annual rate of about 260 feet, while Mustang Island has been receding; and as the channels do not move toward but away from the resultant, there should be no cause for doubt as to the direction of the movement, excepting to those who cannot correctly interpret nature's record.

In further support of this inversion of the facts, the statement is made that the foreshore on the northerly side of the jetty shows a loss or scour of 1,270,000 cubic yards since 1895, and that there is no indication of this material having moved seaward, nor has it gone through the opening between the breakwater and the shore into the harbor, and as it would be inconsistent for the argument to have it travel southward, he adds:

"Of course this sand cannot have gone to the south over the breakwater, otherwise there certainly would have been a fill close behind the latter," so it must have gone north, and the assumption is thus established.

Unfortunately for this argument the original compact material in place "close behind the breakwater" has been scoured out by the natural currents even to a depth of over twenty feet and close to the breakwater, as the author admits, consequently any loose sand carried over the breakwater would, *à fortiori*, be much less apt to be lodged in these currents and would be at once carried out and around the sandy spur to the southward, as has happened and as is quite evident from the comparative charts; so that the statement by the writer is true that not only has this incomplete breakwater removed about 600,000 cubic yards in place, but has prevented the deposition of a much larger amount drifting in from the north through the gaps and over the unfinished portions of the structure. This action is so manifest as scarcely to require so long an explanation, but for the misconstruction which has been put upon it. At Cumberland the drift moved over the jetty and across the

new channel in a similar manner and passed on to the southward. The testimony of nature is worth far more as to facts than that of interested and superficial observers, and yet, in view of his own admission that the evidence of the northward movement "is mostly negative," the writer, to sustain his effort to condemn the theory as fatally defective and to demonstrate an error in location, must, perforce, invert the testimony of nature to accommodate a preconceived theory. (For the evidence see Doc. 137, H. R., 55th Cong., 2d Sess., Charts No. 6; survey of 1854; No. 7 of 1868; No. 8 of 1891, etc.) A superficial glance at these will show the prevailing direction of the drift and the loss of depth in the channel until improved by the reaction breakwater.

Such statements might be ignored were it not that the errors which lead to them have involved the country in such large and useless expenditures with injurious results to our commerce, and have inflicted upon us an enormous annual and avoidable expense for maintenance of channels by dredging, which the author recommends be done by day's labor and with Government plants, thus destroying competition.

Yet all this expenditure does not seem to have had even an educational value upon the author of the report under consideration, who recommends its continuance.

Hence it is not surprising, after such an ingenious misconstruction of data "mostly negative," and which makes the littoral drift come from the southwest or in a direction opposed to that of the drift of the inlet for at least fifty years, that the author reaches these erroneous

"CONCLUSIONS."

"1st. The theory of the reaction breakwater is fatally defective in the following particulars, viz.:

(*a*) It provides for no force or resistance to hold the currents against the breakwater. Such provision would usually mean a second jetty.

(*b*) Should it increase the depth, such increase is limited and beyond that an undue amount of dredging would probably be necessary.

(*c*) If successful in deepening the channel, it would probably move the bar seaward and the seaward extension of the works appear impracticable.

(*d*) It makes no provision against the channel being driven too close to the breakwater for the safety of itself or shipping, by sand coming from the opposite direction or by the current being directed against the jetty in accord with the theory.

That these opinions are hypercritical will be seen from their contradictory character, for in (*a*) it is said there is no provision to hold the current against the breakwater, while in (*d*) it is said that the channel may be driven too close by sand from the opposite direction. In (*b*) the objection is made that should an increase of depth result, such increase would involve an undue amount of dredging; or in short, although the currents scour out a natural channel, defended from the resultant sand movements by the breakwater, there would still remain a larger than before volume to be removed by dredging. (*c*) The result of any deepening might extend the bar seaward and the breakwater could not be extended.

Any material carried to the outer slope would be ejected in deeper water where the littoral current and wave action at head of breakwater would prevent its deposition, as the incomplete results have shown, and, if necessary, a considerable extension of the works seaward is quite possible without injury to navigation. The facts, however, at Aransas, as previously stated, are so confirmatory of the theory that they have been recognized by impartial juries at the Paris Exposition and the National Export Exposition as worthy of their highest awards, while the American Philosophical Society and the Franklin Institute, after thorough and extended investigations, have also granted their highest honors to the inventor.

In view of these findings of experts, it is somewhat confusing to read further in the official report of the officer in charge of the work at Brunswick:

"The only apparent example of such construction that has been tried is at Aransas Pass, and that is no test of the theory at all, as the breakwater is not located according to the theory, and the beneficial results produced are not the result of the reaction breakwater as such but by incomplete twin jetties." If such be the case, then the maritime engineers and societies who have recognized the merits and results of the incomplete work at this place must have stultified themselves, and it remains for the author of the report to cite a single instance where similar results have been secured by "incomplete (or even complete) twin jetties" in the same time or for the same cost.

As the depth entirely across the bar has been increased from six to over fifteen feet at a cost of about $30,000 per foot, with a large area having depths exceeding twenty feet, it remains a fact that there is no record known to the writer exhibiting equal efficiency and economy.

Yet the report illogically concludes from these erroneous premises and misconstructions: "For these reasons, a single reaction breakwater is not recommended for the improvement of Brunswick bar."

How groundless "these reasons" are will no doubt appear from the previous analysis, but the *primum mobile* for the failure to recommend it may be better understood by stating that for some fourteen years the attention of the Government has been invited to this improvement through its engineer officers. As long ago as the 16th of March, 1888, a Board reported to the Chief of Engineers the following conclusion:

"The views are purely theoretical, are unconfirmed by experience, and contain nothing not already well known which has a useful application in the improvement of our harbors."

The Board, however, cited no precedents, although requested to do so, and all applications for permission to make a demonstration remained unanswered.

Again, in 1890, the officer in charge of the jetties at Cumberland Sound, after mature study, submitted on his own responsibility a plan involving the use of a single, curved, reaction breakwater, properly located on the windward side of the channel, at an estimated saving of $1,108,004, of which $125,000 was for the removal of part of the south jetty, which he reported as being "improperly located." On March 11, 1891, a Board of Engineers, composed with one exception of the same officers who had made the original adverse report, stated as follows:

"The Board does not think that a single jetty on the north side of the channel, curving gently to the south, would secure the deep water needed, but is of the opinion that two jetties will be needed. . . . . The opinion that such a curved channel conforms to the natural requirements of the site and opposes the action of the natural forces less than any other, is believed to be fallacious."

In consequence, work on the two jetties was continued with the disastrous results already stated.

Again, after all former attempts to deepen the channel at Aransas

Pass had failed, and the reaction breakwater was partially built with the results given, the private funds became exhausted and the Government was asked to appraise the value of the work done, take over the breakwater and continue it immediately. A Board of Engineers reported in 1897, just after the obstructing old Government jetty had been breached, that:

"There does not seem to be any probability that the jetty as now constructed will of itself secure and maintain any considerable increase of depths in a navigable channel of proper width. The Board is of the opinion that the value to the Government of the works for the improvement of Aransas Pass is nothing."

The depth was then nine and a quarter feet. It is now fifteen feet, and as yet no work has been done, although Congress made an appropriation more than two years ago of $60,000 to remove the remains of the old jetty built across the channel and on its leeward side. This is now buried, as previously stated, by the action of the breakwater under the bottom of the channel, and is a barrier to its further deepening.

Finally comes this Report on the Brunswick Bar, which condemns the theory as well as its application as being erroneous even in the face of the indisputable evidence of nature.

These statements are made to illustrate the operation of the law of conservatism which ever attends the path of progress to retard her too rapid strides. Its consideration would divert this analysis of physical fallacies, facts and forces to the domain of metaphysics and is therefore not pursued further.

4. Twin Jetties.

This is the method most generally used in efforts to create channels and the record of their experience is quite suggestive. At the mouths of large sedimentary rivers, emptying into nearly tideless seas, they have been reasonably successful, but for tidal inlets their utility is very limited. The report says: "Apparently the only examples of high tide jetties in the United States are at Sabine Pass, Galveston, and Yakina Bay, Oregon."

This statement suggests the necessity for greater research on the part of the author, since the well-known jetties at South Pass were built above high water, as are also those at Newburyport, Mass.; New Haven, Conn.; Manasquan, N. J.; Brazos River, Tex., and at other points, while both jetties at Yakina were originally de-

signed to rise only to half-tide, but both were subsequently raised above high water to make them, if possible, effective. It is not the purpose of this paper to review the results of works of this class, but their sequel shows that they have not fulfilled the expectations of their designers and that they have not arrested the advance of the bar seaward nor have they given the anticipated depths, with the exception of South Pass. This, however, has caused a rapid shoaling in the entire channel above the jetties in consequence of over-contraction, and necessitates the maintenance of the depths by dredging for a distance of many miles because of the elevation of the flood plane and bed of the stream by sedimentation.

Hence the necessity for an early removal of the bar at the South-west Pass.

But to return to the discussion. The author suggests that to arrest sand movements entirely, high tide jetties are requisite, and cites those at Yakina Bay as a type, as having "increased the depth from seven to fifteen feet at mean low water, and, so far as the records show, without as yet producing any new bar seaward of the jetties." It may suffice to state, on the contrary, that while the original depths at low water were seven to nine feet, the latest annual report of the Chief of Engineers for 1900 says on p. 4298: "There is at present, about one-half mile from the end of the jetties, a crescent-shaped bar almost enclosing the entrance and having from eight to twelve feet of water over it at low water. Around the south end of this shoal there is a channel having a least depth of thirteen feet[1] at low tide. This bar has apparently shoaled somewhat since the survey of 1895." The report of 1887, when only a portion of the south jetty was built, also shows a low tide channel of thirteen feet, and the officer then in charge calls attention to the movement of the bar seaward toward a reef of rocks.

These official statements would appear to discredit the assertions of the author as to an increase of depths to fifteen feet and no advance of the bar seaward.

In commenting further upon twin jetties, the author remarks: "Jetties built to a height sufficient to stop the sand flow from both sides and also high enough to control the tidal flow should be expected to reproduce at the bar the depths at the gorge." Experience does not seem to confirm this expectation, since nature fur-

[1] The chart shows but ten feet. This may be an error, however.

nishes no illustration of a deep pocket at both ends of a contracted pass, whether natural or artificial. High tide jetties, unfortunately, greatly obstruct the ingress of the tides and hence reduce the volume available for ebb scour, and it was to meet this condition that the reaction breakwater was, in part, designed with such marked results.

The former method proposed for overcoming this objection was, as the author states, to increase the width between the jetties on the bar and to build them only to near low-water mark, but, as he adds, the scouring effect has not produced depths great enough for navigation—although "dredged channels can be maintained at comparatively moderate cost," as at Charleston, which is cited as "a good example."

Here, again, it would seem that the reference is unfortunate, inasmuch as the Government dredge was unable to maintain the channel on the ranges, and a new and more powerful machine is building, while the bar has reformed three-quarters of a mile beyond the jetties, and the outer twenty-six-foot contour is 1.5 miles to seaward of them. The jetties were reported completed several years since, at a cost of about $4,000,000, but they have failed to hold the bar, which has eluded them and gone to sea, where dredging is now required in open water. The author recognizes this feature in his report, wherein he says:

"The Charleston jetties have been left low near the shore for the double purpose of economy in construction and to freely admit the flood tide to avoid reduction in the tidal prism. It is not unreasonable to believe that the quantity of dredging necessary and the quantity of sand that have been scoured seaward has been materially increased by sands driven over the low portion of the north jetty by the northeast storms. Such sand may be expected to be driven into the channel, usually over both jetties, if they are left low, even though the predominance of sand movement is in one direction."

This statement is undoubtedly correct and clearly recognizes one of the defects of twin jetties, submerged at their shore ends, and yet one of the officers recently in charge of that work stated officially:

"I have been out on that bar for thirteen years, day in and day out. . . . . I know that on top of those rocks there never was sandf . . . . I have never found it there." His contention being that it did not travel over the submerged ends of the jetties.

The value of this kind of evidence may be appreciated when it is remembered that the rock composing the inner end of the jetties is submerged and subject to the action of the breakers, so that no sand can lodge upon it as it is driven over. The history of the Charleston operations, covering more than twenty years, is too extensive to be further considered in this connection, but it has sufficed to cause the abandonment elsewhere of the submerged jetty theories of 1879.

5. Dredging.

Having reviewed the several methods of securing depths by auxiliary structures and by dynamite, the author concludes that:

"All things considered, in the present state of the science of bar improvement, dredging appears to be by all means the most economical and satisfactory method for such work at this place," because, as he adds, "the partial improvement of Brunswick bar by dredging, while it has been very expensive as to the rate per cubic yard, has been quite successful as to the permanence of the improvement."

The permanence of the channel is here attributed to dredging, and the effects of the dynamite are apparently ignored.

Had a straight channel been dredged through the bar at any time, it would soon have been obliterated; but instead thereof the integrity of the bar was disturbed by heavy charges of dynamite, while the dredge was used as an auxiliary to hasten the formation of the channel, which selected its own locus on curved lines. An inspection of the maps shows that the thalweg of the channel follows a reverse curve, having a trace similar to that of the plan of the reaction breakwater as designed for Aransas Pass. It indicates, therefore, the general form of the curve of greatest ebb energy in open water, and as such confirms the correctness of the theory of the reaction breakwater. The fact that currents move on curved lines is generally ignored in dredging operations with prejudicial results.

In considering the methods to be pursued at Galveston, the Board of 1886 reported: "The methods are (1) by dredging alone; (2) by using tidal scour between jetties, aided, if necessary, by dredging. As to the first method, it has already been tried unsuccessfully. . . . . There is not sufficient prospect of results commensurate with the cost of dredging being obtained and maintained to justify

further experiment." The second method of twin jetties was therefore resorted to, but the tidal scour did not deepen the bar as expected, since the jetties were 7000 feet apart. Hence a cut was dredged along the axis of the channel. It was begun April 11, 1895, when the depths were about fifteen feet on the crest of the bar. But it did not remain straight, as the resultant drift soon swung the channel to the south on its normal curve, with a radius of five miles, and it now crosses the line of the south jetty produced. Many instances might be cited of the failure to secure channels in the open sea by dredging, especially where there is a prevailing littoral drift, but the fact is so generally recognized that it is not necessary to extend this discussion further than to add a few words as to cost.

It has been officially certified that the total cost of the work done by the contractor at Brunswick was $253,646.15 for a gain in depth of 5.6 feet, giving $45,293.95 per foot of depth secured. The author, however, states that dredging has been done on the Mersey bar at Liverpool for two and one-third cents per cubic yard, and says that fifteen cents is a fair price for this class of work. He then proceeds to estimate the quantity of material in place which it would have been necessary to remove to secure the present channel, and figures that 125,000 cubic yards at fifteen cents would have cost but $18,750 for the entire work, and that the actual cost of $253,646.15 was therefore excessive. He concludes: "The cost to the Government of all material removed, whether usefully removed or otherwise, has been $1.13 a yard, more than seven times the cost of ordinary dredging."

If it were only necessary to remove 125,000 yards to secure the channel, the cost would have been $2.03 per yard. At $1.13 there must have been 224,400 yards taken out, but as a matter of fact the actual cube of excavation was very much larger than this, since the enormous bank "which always moves very positively in one direction" was constantly supplying material to the channel.

The radical error in this computation of cost arises from regarding the volume of the material as a constant over a given area of the bar, and considering only the net loss or gain due to local changes in form of cross section. The absurdity of this method is seen from the table on page 14 of the report, wherein a strip 6370 feet long and of variable widths is taken for an estimate. I-

400 feet wide be used there is found to be a net fill of 77,000 cubic yards; for 600 feet width the fill is 113,000 cubic yards; for 800 feet it is 166,000, and for 1000 feet width it is 208,000 yards—in every case a fill, yet between the dates taken for this comparison the channel passing through this strip was deepened by dynamite, between April, 1891, and February, 1897, from 13.3 to 16.6 feet, a gain in depth of 3.3 feet.

Had the contractor been paid for excavation by place measurement for this area, therefore, he would have had to go into bankruptcy, since over 200,000 yards more were deposited than removed, and yet a deeper channel was created.

Moreover the dredging was not begun until August, 1896, and then it was merely to pump the material into the current until the fall of 1897, when bins were used to carry it out to sea, by which time the depths were increased nearly four feet. Even after this dynamite in 100-pound charges continued to be used, so that it is incorrect to regard this as a dredged channel when 168,000 pounds of explosives had been used to secure it.

Furthermore the report states (p. 17): "The north shoal has certainly been moving south for the last forty years. . . . . About 1,500,000 cubic yards have been added to its southern face since 1891." . . . . Also, "the north face of the south breakers . . . . has been scouring away correspondingly to the growth of the north shoal since 1857, and quite rapidly since 1888 (about 3,000,000 cubic yards and 1000 feet in width, scoured away between 1888 or 1890 and 1897 or 1900)." These admissions show large movements of bar material and an excess of about 1,500,000 cubic yards of scour during this period, and in the vicinity of dynamite operations, yet it is claimed that the deepening was "probably due to natural causes."

It would be a remarkable freak of nature that, with a bar drifting from north to south, there should have been a deposit of 1,500,000 yards on the one hand, and a scour of 3,000,000 yards on the other, between which a channel might have been dredged by the removal of 125,000 yards at a cost of $18,750, which would have been permanent, or else that "nature" should have concluded to reverse her machinery without apparent cause, and that, too, just at the time when dynamite was applied to the deteriorating bar, all for the benefit of a contractor who had previously undertaken to create a channel by the use of high explosives to save the port from ruin.

It may well be asked why no one had previously discovered that a channel could have been secured here for the petty sum of $18,750, and, if so, why it was not done instead of estimating millions of dollars for jetties and dredging plants, or why is not a permanent channel secured at other points on our alluvial coasts for similar trifling expenditures?

The fact is that this is not a dredged channel, but one secured by the effect of violent explosives on the bar which assisted the ebb currents to select and create the best path to sea, and no credit is given in the account to the large excess of material which was removed by such explosions. Any estimates, therefore, based on net measurements in place are utterly unreliable and the resulting price per unit is of no value in ascertaining the cost. The only reliable method is the cost per foot of depth actually secured, and on this basis the work has cost only about ten per cent. of that elsewhere, with far better and more permanent results. Hence dredging alone should not be recommended.

In a science necessarily so empirical as this it would seem that the best guide to results would be to make a careful diagnosis of the natural conditions and forces available, and then utilize them to the best advantage. This was the plan pursued at Aransas Pass, which is conceded to be the only instance of the kind on record; while the author would have it appear that it is fatally defective and is merely a case of two jetties. But no two jetties, so far as the writer's researches have gone, can be cited which have produced like results in practice with a tide of but fourteen inches, and with an obstructing wall across the bottom of the channel.

In conclusion, it would seem that of the several methods proposed for bar removal by the use of single or double jetties or by the reaction breakwater, the latter, so far as it has been tested, fulfills better than any other the conflicting requirements of harbor entrances, costs less than half as much and is far cheaper to maintain. Had this plan been adopted in 1888 it is believed, in view of subsequent events, that it would have saved the Government not less than $25,000,000 in the cost of jetty or breakwater construction and at least as much more (if capitalized) in the cost of maintenance, while the indirect benefits to commerce resulting from an earlier opening of our seaports for deep vessels would have exceeded the sum of both of these items.

Dr. Hays moved the following preambles and resolutions which were unanimously adopted:

Whereas, The American Philosophical Society is and always has been a Society of national scope, whose place of meeting was originally fixed at Philadelphia for reasons of convenience now less potent than formerly; and

Whereas, The growth and wide extent of our country and the multiplication of local societies tends to keep from our regular meetings those members who do not reside within a short distance of Philadelphia; and

Whereas, It is desirable that measures be taken to bring the distant members into more active participation in the work of the Society; therefore, be it

Resolved, 1. That a committee of five be appointed by the President to consider the advisability and, if deemed advisable, to arrange for a general meeting at a time most convenient to all the members;

2. That this meeting shall cover one or more days as may be considered advisable, and it is hoped that the high scientific character and broad interest of the papers to be presented shall insure the fair attendance of a good proportion of distant members;

3. That this Committee shall have power to add to its number and to make all necessary arrangements to further the success of the proposed general meeting.

The meeting was adjourned by the presiding officer.

9. Vol. 43, No. 87—"Exercise in French, No. 5," "Letter to Mme. B. transcrib'd and corrected by her," in Franklin's handwriting, and her comments, No. 98.

10. Vol. 43, No. 116—"Plaidoyer pour Mme. Brillon contre M. Benjamin Franklin."

11. Vol. 45, No. 180—Franklin's letter in French to Mme. Brillon.

12. Vol. 22, No. 8—Miss Shipley's acknowledgment, dated May 6, 1781, of a copy of "The Dialogue between F. and the Gout."

13. Vol. 32, No. 51—Carmichael's letter, Madrid, July 9, 1784, saying that F.'s "little works" will soon appear in a Spanish dress, followed by a letter—

14. Vol. 32, No. 63—from Count Campomanes, dated Madrid, July 26, '84, thanking F. for the gift received through Carmichael.

15. Temple Franklin's Letters to his Father (Vol. 32, Nos. 95 and 133).

16. Vol. 34, No. 167—Miss Shipley, November 13, 1784, with thanks for "The Art of Procuring Pleasant Dreams," and asking "where F. read that Methusalah slept in the open air? I have searched the Bible in vain to find it."

17. Vol. 44, No. 12—"The Intended Speech for the Opening of the first session of the present Parliament, viz., Nov. 29, 1774," endorsed "D. Hartley, Oct. 3, '86."

18. Vaughan's letter of April 28, 1778 (Vol. 9, No. 93)—Letters to Franklin, April–May, 1778.

In adding Vaughan's letter of April 28, '78, I call attention to the value and importance of his correspondence; he and Hartley were among Franklin's English friends, who through all the period of the Revolution kept him well informed as to the trend of parties and public opinion in England. Authentic reports of Chatham's famous last speech are very rare, and a Calendar of the Franklin Papers would enable historical students to refer to them for much valuable information. The printing of these papers by this Society will, I am sure, invite attention to the large amount of valuable material now practically hidden away in this collection, needing only a Calendar to make it available and useful to students. It may be said that the Department of State has never yet printed any Calendar of the Collection of Franklin Papers bought by the Government of the United States from Stevens. It is roughly

estimated that they are in bulk about one-fourth, those in the collection of the Philosophical Society—about three-fourths of all the papers left by Franklin. The Government collection is largely made up of State Papers used by Temple Franklin in his publication of his grandfather's works; those here are largely personal papers, many of them perhaps thought by Temple Franklin not worthy of printing, yet in them there is that personal note which gives us Franklin as he was in the palmy days at Paris, where he filled so large a place in the public eye.

THE DEFORM'D AND HANDSOME LEG.[1]

There are two Sorts of People in the World, who with equal Degrees of Health, & Wealth, and the other Comforts of Life [are] *become*, the one happy, and the other [Unhappy] *miserable.*—This arises very much [solely] from [In almost ever] the different *views* in which they consider Things, Persons & Events; and the Effect of those different Views upon their *own* Minds.

In whatever Situation [a] Men can be plac'd, they [will] *may* find Conveniences & Inconveniencies: In whatever Company; they [will] *may* find Persons & Conversations more or less pleasing. At whatever Table, they [will find] *may meet with* Meats & *drinks* of better and worse Taste, [things] *Dishes* better & worse dress'd: In whatever Climate they will find good and bad Weather; Under whatever Government, they [will] *may* find good and bad Laws, and good and bad Administration of those Laws. *In every Poem or Work of Genius they may see Faults & Beauties:* In every Face they may discover [Beauties] *fine Features* & Defects, good & bad Qualities. Under these Circumstances, the two Sorts of People [I have] *above* mention'd fix their Attention, those who are to be happy, on the [convenient] *Conveniencies of Things*, the pleasant Parts of Conversation, the well-dress'd Dishes, the Goodness of the Wines, the [agreeable] *fine* Weather; [the] &c. &c. *and enjoy all with Chearfulness.* Those who are to be unhappy, think & *speak* only of the contraries. Thence they are continually discontented themselves, and by their Remarks sour the Pleasures of Society, *offend* [*disgust*] *Personally many people*, and make themselves [where] every where disagreeable.

If this [different] Turn of Mind was founded in Nature, such unhappy [*People*] *Persons* would be the more to be pitied: But as th[at]*e* Disposition to criticise & be disgusted, is perhaps taken up originally by Imitation, and is unawares grown into a Habit; [and] which tho' at present *strong* may *nevertheless* be cured when those who have it are convinced of its

[1] Erasures in the manuscripts are shown by being placed between [ ]. Insertions are printed in *italics.*

bad Effects on their [Happiness] *Felicity;* I hope [a] *this* little Admonition may be of Service to them,—and put them on changing a Habit, which tho' in the Exercise is [merely] *chiefly* an Act of Imagination yet it has serious Consequences in Life: [To] *as it* brings on real *Griefs &* Misfortunes: For as *many* [*have been*] *are offended by, &c.* no body *well* loves this Sort of People, no one shows them more than the most common.—*The Franklin Papers, Vol. 50.*

AVERTISSEMENT.

Madame B. Est une Dame fort aimable et qui posséde un Talent distingué pour la Musique; Elle demeure à Passy où elle est en Société avec M^r^. Franklin, ils avoient dans l'Eté de 1778 Eté passés ensemble une Journée au Moulin Joly où ce même Jour Voltigeoit sur la Riviere un Essaim de ces petites Mouches que l'on nomme Ephemeres le que le Peuple appelle de la Manne. M^r^. Franklin les examina avec attention et envoya le lendemain à M^de^. B. la Lettre dont voicy la Traduction.

Vous pouvez, ma chere Amie, vous rapellez que, lorsque nous passames dernierment cette heureuse Journée dans les Jardins délicieux et la douce Société du Moulin Joly, je m'arretai dans une des Promenades que nous fimes et que je laissai la Compagnie la continuer quelque temps sans moi.

On nous avoit montré un nombre infini de Cadavres d'une Espece de Mouche que l'on nomme Ephemere dont on nous dit que toutes les génerations successives etoient nées et mortes dans le même Jour. Il m'arriva d'en remarquer sur une feuille une Compagnie Vivante qui faisoit la conversation.

Vous savez que j'entends tous les Langages des Especes inférieures à la nôtre, ma trop grande application à leur Etude est la meilleur Excuse que je puisse donner du peu de progres que j'ai fait dans votre Langue charmante; La Curiosité me fit écouter les propos de ces petites Créatures, mais la Vivacité propre à leur Nation les faisant parler trois ou quatre a la fois, Je ne pus tirer presque rien de leurs discours. Je compris cependant par quelque Expressions interrompues que je saisissois de temps en temps qu'ils disputoient avec Chaleur Sur le mérite de Deux Musiciens Etrangers l'un Cousin et l'autre un Bourdon. Ils passoient leur temps dans ces Debats avec l'air de Songer aussi peu à la brieveté de la Vie que S'ils en avoient été assurés pour un mois. Heureux Peuple me dis-je, vous vivez certainement sous un Gouvernement Sage Equitable et moderé, puisqu'aucun grief publie n'excite vos plaintes et que vous n'avez de Sujet de Contestation que la perfection où l'imperfection d'une Musique Etrangere.

Je les quittai pour me tourner vers un Vieillard a Cheveux Blancs qu

Seul Sur une autre feuille Se parloit à lui même. Son Soliloque m'amusa, Je l'ai écrit dans l'Espérance qu'il amusera de même celle à qui je dois le plus Sensible des plaisirs, Celui des Charmes de Sa Société et de l'harmonie celeste des Sons qui naissent Sous Sa main.

" C'etoit disoit-je l'opinion des Savans philosophes de notre Race " qui ont vécu et fleuri longtems avant le présent âge, que ce Vaste " monde (le Moulin Joly) ne pouroit pas lui même Subsister plus de Dix " huit heures, et je pense que cette opinion n'etoit pas Sans fondement, " puisque par le mouvement apparent du grand Luminaire qui donne la " Vie à toute la nature et qui de mon tems a d'une maniere Sensible " considerablement decliné vers l'ocean[2] qui borne cette Terre, Il faut qu'il " termine Son Cours à cette Epoque, S'eteigne dans les Eaux qui nous " Environnent Et livre le monde à des glaces et des Ténèbres qui " ameneront nécessairement une morte et une destruction universelle, " J'ai vécu Sept heures dans ces dix huit; C'est un grand age, ce n'est " moins de 420 Minutes, Combien peu d'entre nous parviennent aussi " loin? J'ai vu des générations naitre, fleurir et disparoitre. Mes amis " Presents sont les Enfants et les petits Enfants des amis de ma jeunesse " qui helas! ne Sont plus, Et je dois bientot les Suivre, car par le " Cours ordinaire de la Nature je ne puis m'attendre qu'oiqu'en bonne " Santé a vivre Encore plus de 7. a 8. minutes: que me Servent a pre- " sent tous mes travaux, toutes mes fatigues pour faire Sur cette feuille " une provision de miellée que je ne puis vivre assez pour consommer? " Que me Servent les Débats politiques dans lesquels je me suis Engagé " Pour l'avantage de mes Compatriotes habitans de ce Buisson, ou mes " Recherches philosophiques consacrées au bien de notre Espêce En " Général? En politique que peuvent les Lois Sans les Moeurs,[3] Le " Cours des Minutes rendra la génération presente des Ephemeres " aussi corrompue que celle des autres Buissons plus anciens Et par " Consequence aussi malheureuse, Et en Philosophie que nos progres " Sont lents? helas L'art est long Et la Vie Est courte[4] mes amis vou- " droient me consoler par l'idée d'un nom qu'ils disent que je laisserai " après moi, Ils disent que j'ai assez vécu pour ma gloire Et pour la na- " ture; mais que Sert la renommée pour un Ephemere qui n'existe plus? " Et l'histoire que deviendra-t-elle lorsqu'a la 18e. heure, le monde lui " même, le Moulin Joly tout entier, Sera arrivé a Sa fin pour n'etre " Plus qu'un amas de Ruines?

" " Pour moi apres tant de Recherches actives, il ne reste de bien réel " que la Satisfation d'avoir passé ma Vie dans l'intention d'etre utile, " la Conversation aimable d'un petit nombre de bonnes Dames Ephe- " meres Et de temps en temps le doux Sourire Et quelques accords de la " toujours amiable Brillante.—*The Franklin Papers, Vol. 50, No. 39a.*

[2] La Riviere de Seine.
[3] Quid leges sine moribus? hor.
[4] Hipocrate.

PASSY, NOV. 16, 1779.

J [e recus] *'ai Recu* les deux Lettres de ma chere Amie, l'une [pour] *pour le* Mercredi, l'autre [pour] *pour le* Sam[m]edi ; c'est aujourd'hui encore Mercredi. [Mais] Je ne merite pas [d'avoir une pour ce jour], [*d'en*] *d'en avoir encore*, parceque je n'ai pas fait reponse aux [autres] precedentes. Mais *tout* indolent, [comme] *que* je suis, [& averse] *et quelque aversion que j'aye* à ecrire, la Crainte de n'avoir [pas] plus de vos charmantes Epitres, si je ne contribue [pas] *aussi* ma part pour soutenir la Correspondance [m'oblige] *me force* de prendre [ma] *la* plume. Et comme M. Brillon [a] *m'a mandé* si obligeamment qu'il part demain Matin pour vous voir moi, au lieu de passer [le] *ce* Mercredi[s] au soir, comme j'ai fait si long tems *de* ses predecesseurs du même nom, en vôtre [delicieuse Compagnie] douce Société, Je me [mis a] [*retira dans ma*] *suis mis à mon ecritoire pour* le passer [en] *à* pens[ant]*er* [de] *à* vous, [en ecrivant à vous], *et à vous ecrire* & [en lisant] *à lire* & reli[sant]re ce que vous m'avez [ecrit a moi] [*si elegamment*] si delicieusement écrit.

Je suis charmé de votre Definition du Paradis, & de [votre] *vos* Plans pour y vivre. J'approve aussi *très* fortement la Conclusion que vous faites, qu'en attendant il faut tirer de ce bas monde tout le bien qu'on en peut tirer. A mon Avis, [nous c'est bien] *il est très* possible pour nous d'en tirer beaucoup plus de bien que nous n'en [tirons] *tirons* & d'en souffrir moins de mal, si nous [voulussions] *voulions* seulement prendre garde de *ne donner pas trop pour nos s*[*ou*]*ifflets*. Car il me semble, que la plus-part des Malheureux qu'on trouve dans le monde sont devenus tels par *leur* Negli[ss]*gence* de cette Caution.

Vous demandez ce que je veux dire? Vous aimez les [Contes] *Histoires* & vous m'excuse[rai]*rez* si je vous en donne une *qui me* [*re qui*] *regarde* [de] moi même. Quand J'etois un Enfant de *5 ou 6* ans, mes Amis, [sur] un Jour de Fête, remplirent ma petite Poche de [oooo] *sous*. [J'Iroit] J'allai[t] tout de suite à une Boutique ou on vendoit des Babioles, [&] *mais* étant charmé du [la] Son d'un Sifflet *que je rencontrois en chemin dans le mains d'un autre petit garcon* je *lui* volontiers offr[oit] *ais* & donnai volontiers pour cela tout mon Argent. [Quand je ret] Revenu chez moi, sifflant par toute la Maison fort [satisfait] *content* de mon Achat *mais fatiguant les Oreilles de toute la Famille*, mes Frères, mes Sœurs, mes Cousines, entendant [combien j'ai donne] que j'avois *tant* [*tant*] donné *tous* pour ce mauvais Bruit, [tous ils] me dirent que c'étoit dix fois plus que la Valeur ; [& ils] *alors ils* me [fasoit] *firent* penser [du] *au* Nombre de[s] bonnes choses, que je pouvois acheter avec le reste [du] *de ma* Monnoye *si j'avois ete plus* [*sage*] *prudent* & *ils* me ridiculi[ssent]*erent* tant de ma Folie, que je pleuroi[t]*s* de *cette* vexation ; & la Reflexion me donnoit plus de Chagrin, que le sifflet [peut me donner] d[u]*e* plaisir.

PASSY, Nov. 16, 1779.

I received my dear Friend's two Letters, one for Wednesday & one for Saturday. This is again Wednesday. I do not deserve one for to day, because I have not answered the former. [But you will] But indolent as I am, and averse to Writing, the Fear of [receiving] having no more of your [*ever*] pleasing Epistles, if I do not contribute to the Correspondence, obliges me to take up my pen. And as M. Brillon has kindly sent me Word, that he sets out to morrow to see you, instead of spending this Wednesday evening as I [us'd to do Since these] have long done its Namesake's, in your delightful Company, I set down to spend it in thinking of you [and] in writing to you, *in reading over and over again your Letters.*

I am charm'd with your Description of Paradise, & with your Plan of living there. And I approve much of your Conclusion, that in the mean time we should draw all the Good we can from this World below. — In my Opinion we might all [do] *draw* more *good* from it than we do and suffer less Evil, if we [but careful enough] *would but take care* not to *give too much for our Whistles.* For to me it seems that most of the unhappy people we meet with, are become so by the Neglect of that [Circumstance] Caution.

You ask, what I mean?—You [ask what I] love Stories, and will excuse my telling you [a little] one of myself. When I was a Child of 7 Years old, my Friends [on a] *on a* holiday [fill'd my] fill'd my little Pocket with halfpence. I went directly to a Shop where they sold Toys for Children; and being charm'd with the Sound of a Whistle, *that I met by the way in the hands of another Boy,* I voluntarily offer'd and gave all my Money for it. When I came home, *whistling all over the House, much pleased with my Whistle, but disturbing all the Family,* my Brothers, Sisters & Cousins understanding the Bargain I had made, told me I had given four times as much for it as it was worth; put me in mind what Good things I might have bought with the rest of the Money, and laught at me so much for my folly that I cry'd with Vexation; and the [Ch Chagrin I suffer'd by it was greater] Reflection [on] gave me more Chagrin than the Whistle gave me Pleasure.

[Co] *Cet accident fut* cependant, [etoit] dans la suite [ut] de quelque utilité pour moi, l'Impression restant sur mon Ame; [tant que quand] *de sorte que lorsque* j'étois tenté d'acheter quelque chose qui ne m'etoit pas necessaire, je disois [a] *en* moiméme: *Ne donnois pas trop pour le Sifflet;* Et j'[ai sauve] *épargnois* mon Argent.

Devenant grand Garcon, [&] entrant [dans] le Monde, & observant les Actions des Hommes, je [pensois] *vis* que je rencontrois [*un*] Nombre [*des gens*] *de gens qui donnoient trop pour le Sifflet.*

Quand j'ai vû *quelqu'*un, qui, ambitieux [du] *de la* Faveur de la Cour, [sacrifiant] *consumant* son tems en [Attendance des] Assiduités aux [Levees] *Levers*, son Repos, sa Liberté, sa Vertu & peut-être ses vrais Amis, pour obtenir *quelque petite Distinction;* J'ai dit [a] *en* moiméme, *Cet homme donne trop pour son Sifflet.* Quand [j'ai] *j'en ai* vu une autre [entété] [*personne*] *avide* [*d'obtenir*] de Popularite [se rendre populaire] *de se rendre populaire* & pour cela s'occupant toujours de Contestations publiques, negligeant ses [propres] Affaires *particulieres* & les ruinant par cette Negligence, [Il] [*elle*] *il* paye, *trop* ai-je dit, [*trop*] *pour son Sifflet.*—Si j'ai connu un [Miser] Avare, qui renoncoit à toute [especе] *maniere* de vivre commodement, à toute le plaisir de faire le bien aux autres, à toute l'Estime de ses Compatriotes; & a tous les [joyes] *charmes* de l'Amitié, pour avoir un morceau de metal jaune. Pauvre homme, [je] disois-je, vous donnez trop pour vôtre Sifflet!—Quand j'ai rencontre [a] un homme de Plaisir, sacrifiant toute *louable* perfectionnement [laudable] de son Ame [ou du] *& toute* amelioration de son Etat aux [gratifications] *volupté* de sens[e] purement corporel[les] [& en les pursuivant] & detruisant sa Santé dans leur poursuite. *Homme trompé,* ai-je dit, *vous vous procurez des Peines au lieu des Plaisirs; vous payez trop pour votre Sifflet!*—Si [je vois] *j'en ai vu* un autre, entété de beaux Habillements, belles Maisons, belle Fournitures, beaux Equipages, toutes au-dessus de sa Fortune & [pour lesquelles il fait des] [*voir*] *qu'il ne se procurait qu'en faisant des* Dettes & [finit] *en allant finir* sa Carriere dans une Prison. Helas, [*dira*] [dis-je], *ai-je dit, Il a payé trop pour son Sifflet!*—Quand j'ai vu une trés belle fille, d'un[e] [disposition] naturel[l] bon[ne] & [douce epouse] *doux mariée* à un homme feroce & brutal, qui la maltraite continuellement [*Quelle pitie*] *C'est grande Pitiè,* ai-je dit, *qu'elle* [*a*] *ait tant payé* [*tant*] *pour un Sifflet!*—Enfin, j'ai conclu que la plus grande partie des Malheurs de[s] [Hommes] l'Espece humaine [ont sa derive] [*vio*] *viennent* des Estimations fausses qu'on fait de *la* Valeur des choses [moyen de qu'on] [*oooooo*] on donne[s] [*oooooo*] trop pour les Sifflets.

Neantmoins je dois avoir *je sens que* de la Charité pour ces Gens malheureux quand je considére qu'avec toute cette Sagesse dont je me vante, il y a certaines choses dans [le] *ce bas* monde si tentantes; par exemple, les Pommes du Roy Jean, lesquelles heureusement ne sont pas à acheter car [si si ils sont pour] *si elles étoient* mises a l'enchere,

je [peux] *pourrois* être trés facilement [mené a] *porté à* me ruiner par *leur* [l]'Achat, & trouver que [j'avois] *j'aurais encore* une fois *donné trop* [*soo*] *pour le Sifflet.*

Adieu ma trés chere Amie, [& mo] croiez *moi* toujours le votre, bien sincerement, & avec une Affection [indiminuable] inaltérable.

[J'ai perdu vos voisines & les miennes & quand je pense [de] *a* vous, je chante pitoyablement

J'ai perdu mon Euridice : rien]—*The Franklin Papers, Vol. 45, No. 149½.*

Je vous ai envoyé, ma trés cher fille, par M^r^. le Ray, l'*Avis à ceux qui veulent passer en Amerique*, que vous m'avez demandé ; & j'ai joint *les Remarques sur la Politesse des Sauvages.* Avec ce Billet, je vous envoye plusieurs autres petites choses, dont on a imprimé quelques Exemplaires dans la Maison, seulement pour nos Amis. Je vous demande bien pardon d'avoir mis parmis les miennes, une de votre façon, qui est certainement trop joli pour être placée en telle compagnie. [Je suis] Si par hazard vous n'avez pas perdu *la belle & la mauvaise jambe*, & *la Morale des Echecs*, vous avez, avec celles-ci, une Collection complette de toutes mes Bagatelles qui ont été imprimées à Passy.—Je suis bien faché que Mad^me^ la Goutte afflige notre cher Ami. Vous sçavez qu'elle m'a donné de bons Conseils autrefois, mais malheureusement ayant trop de foiblesse pour en profiter, je ne puis mieux faire, il me semble, que de les envoyer à notre Ami, à qui ils pourront peut-être être utiles. Cette Dame m'a donné très souvent beaucoup de Chagrin, mais jamais autant qu'à present qu'elle vous empeche de revenir à Passy.—Je prierai pour vous & pour notre pauvre Malade, puisque vous le desirez. Mais si vous étes aimés de Dieu autant que je vous aime, mes Prieres seront inutiles & superflus. Et tout Heretique que je suis, je ne doute pas qu'il aime des Catholiques tels que vous.

à Passy, ce 8 Avril 84.—*The Franklin Papers, Vol. 45, No. 181.*

Dialogue entre la Goute & M. Franklin.

[corrigé et augmenté de plusieurs fauttes par un sçavant et voué de nottes critiques par une femme qui n'est point sçavante.]

à Minuit le 22. Oct. 1780.

M. F[ranklin]. Eh! Oh! Eh! Mon Dieu! qu'ai-je fait fait pour mériter ces Soufrances cruelles?

La Goute. Beaucoup de choses. Vous avez trop mangé, trop bû & trop [*satisfait la paresse de*] [indulgé vos jambes en leur indolence] *indulgé vos jambes en leur Indolence.*

M. F. Qui est-ce qui me parle?

La G. C'est moi-même, La Goute.

M. F. Mon Ennemie en Personne!

La G. Pas votre Ennemie.

M. F. Oui mon Enemie; car non seulement vous voulez me tuer le Corps par vos Tourmens, mais vous tâchez aussi de detruire ma bonne Réputation. Vous me representez comme un Gourmand et un Ivrogne. Et tout le monde qui me connoit, sçait qu'on ne m'a jamais accusé auparavant d'être un homme qui mangeoit trop, ou buvoit trop.

La G. Le Monde peut juger comme il lui plait, il a toujours beaucoup de Complaisance pour lui meme, et quelquefois pour ses Amis. Mais je sçais bien moi, que ce qui n'est pas trop boire, ni trop manger pour un homme qui fait raisonablement d'Exercise, est trop pour un homme qui n'en fait[5] [aucun] *point.*

M. F. Je prends,—Eh! Eh!—autant d'exercise,—Eh!—que je puis, Madame la Goute. Vous connoissez mon Etat Sedentaire; et il me semble, qu'en consequence vous pourriez, Madame la Goute, m'epargner un peu, considerant que ce n'est pas tout à fait ma faute.[6]

La G. Point dutout. Votre Rhétorique & votre Politesse sont également perdues. Votre Excuse ne vaut rien. Si votre Etat est sedentaire,

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[5] *1ere notte*—M. Franklin dit: trop indulgé vos jambes en leur indolence: le corrigeur dit: trop satisfait la paresse de vos jambes—s: *indulgés* n'est pas François; ce n'est pas la faute de Mr. Franklin dont le genie est plus expressif qu'il n'apartient a notre langue; il faut faire recevoir *indulgés* a l'academie et ne point rendre la phrase lâche par ce=satisfait la paresse de vos jambes: au moins auroit on pu dire: trop eu d'indulgence pour l'indolence de vos jambes: cela devasterrait moins=l'original,=ce qui est important quand on corrige le style d'un auteur; mais *indulgés* vont mieux que tout ce qu'on mettra a la place; malheur a qui voudra mettre Franklin en bon François, on gacherra comme à Montagne.

[6] *2de notte*—Il est question d'éxércisse: Mr. Franklin dit: Est trop pour un homme qui n'en fait aucun:—on a rayé *aucun* pour méttre *point*:—je voudrois sçavoir qu'elle différence il y a entre ne *point* faire d'éxércisse ou n'en faire *aucun.*

drez de vos Instructions, M^e^. La Goute, même de vos Reproches, mais de grace pas plus de *vos* Corrections.

La G. Tout au contraire, je ne vous rabattrois pas [un As.] *le quart d'une.* Elles sont pour votre bien. Tenez.

M. F. Oh ! Ehhh !—Ce n'est pas juste de dire que je ne prends aucun Exercise, j'en [ai] *fais* souvent dans [une] *ma* voiture, en sortant pour aller à diner, & en revenant.

La G. C'est de tous les Exercises imaginables le plus léger et le plus insignifiant *que* celui *qui est* donné par le Mouvement d'une voiture suspendue [par] *sur* des Ressorts. En observant la Quantité de chaleur obtenue des differentes Especes de mouvement, on peut former quelque Jugement de la quantité d'Exercise qui est donnée par chacun. Si, par Exemple, vous sortez à pied en hiver, avec les Pieds froids, en marchant une Heure, vous aurez vos Pieds et tout votre Corps bien échauffés. Si vous montez à Cheval, il faut troter quatre heures avant de trouver le même Effet ; Mais si vous vous placez dans une telle voiture, vous pouvez voyager toute une Journée et entrer votre derniere Auberge avec vos Pieds encore froids.—Ne vous flattez donc pas qu'en passant une demie heure dans votre Voiture vous preniez de l'Exercise. Dieu n'a pas donné des Voitures à Roues à tout le Monde, mais il a donné à chacun deux Jambes, qui sont des machines infiniment plus commodes et plus serviables ; soyez en reconnoissant et faites usage[s] des votres. Voulez vous savoir comment elles font circuler vos fluides ên meme tems [qu'ils] *qu'elles* vous transportent d'un lieu à un autre, pensez que quand vous marchez tout le poids de votre Corps est jetté alternativement sur l'une et l'autre jambe, cela presse avec grande force sur les vaisseaux du Pied & [se—Contents]. *refoule ce qu'ils contiennent.* Pendant que le Poids est [protrude] *oté* de ce Pied et jetté sur l'autre, les Vaisseaux ont le tems de se remplir et par le Retour du Poids [cette protrusion] *ce* [repoussement] *refoulement* est repetée, ainsi la Circulation du Sang est accélerée en marchant. La Chaleur produite en un certain Espace de tems est en raison de l'Accélération ; les Fluides sont battus les Humeurs attenuées, les Secretions facilitées, et tout va bien. Les joues prennent [une] *du* Vermeil, et la Santé est établie. Regardez votre Amie d'Auteuil, une Femme qui a reçu de la Nature plus de Science vraiment utile, qu'une demi-douzaine ensemble de vous Philosophes pretendus n'en n'ont tiré de tous vos Livres. Quand elle voulut vous faire l'honneur de sa Visite, elle vint à Pied, elle *se* promene du matin jusqu'au soir, & elle laisse toutes les maladies d'Indolence en [Portion] *partage* à ses Chevaux. Voilà comme elle conserve sa Santé, même sa Beauté. Mais vous, quand vous allez à Auteuil c'est dans la Voiture. Cependant il n'y a [est] pas plus loin de Passy à Auteuil que d'Auteuil à Passy.

M. F. Vous m'ennuiez avec tant de Raisonnements.

La G. Je le crois bien. Je me tais, et je continue mon office, tenez cet Élancement et [cecy] celui-ci.

M. F. Oh! Ohh!—Continuez de parler je vous prie.

La G. Non. J'ai un nombre d'Elancements à vous donner cette Nuit, et vous aurez le reste demain.

M. F. Mon Dieu, La Fievre!—Je me perds. Eh! Eh! N'y at'il Personne qui puisse prendre cette peine pour moi.

La G. Demandez cela à vos Chevaux. Ils ont pris la peine de marcher pour vous.

M. F. Comment pouvez vous être si cruelle de me tourmenter tant pour Rien.

La G. Pas pour Rien. J'ai ici une Liste de tous vos Pechés, contre votre Santé bien distinctement écrite, & je peux vous rendre Raison de tous les Coups que je vous donne.

M. F. Lisez la, donc.

La G. C'est trop long à lire. Je vous en donnerai le[s] Montant[s].

M. F. Faites le. Je suis tout attention.

La G. Souvenez vous combien *de fois* vous vous étez proposé de *vous* promener le matin (Prochain] *suivant* dans le Bois de Boulogne, dans le Jardin de La Muette ou dans le votre; et que vous avez manqué de parole; alleguant quelquefois que le tems étoit trop froid d'autrefois qu'il étoit trop chaud, trop venteux, trop humide, ou trop quelqu'autre chose, quand en verité, il n'y avoit rien de trop qui empechoit, excepté votre trop de Paresse.

M. F. Je confesse que cela peut arriver quelquefois, peut être pendant un An dix fois.

La G. Votre Confession est bien imparfaite, le vrai Montant est cent quatrevingt dix neuf.

M. F. Est'il possible?

La G. Oui; c'est possible, parceque c'est un fait. Vous pouvez rester assuré de la justesse de mon Compte.—Vous connoissez les Jardins de M. Brillon, comme ils sont bons à [promener] [la promenade] *promener.*[8] Vous connoissez le bel Escalier de 150. Dégrés, qui mène de la Terrasse en haut, jusqu'à la Plaine en bas. Vous avez visité deux fois par semaine dans les après midi, cette aimable Famille, C'est une Maxime de votre Invention, qu'on peut avoir autant d'Exercise en montant et descendant un Mile en Escalier, qu'en marchant dix sur une plaine. Quelle belle Occasion [que] vous avez eue de prendre tous les deux Exercises ensemble. En avez vous profité? et combien de fois?

[8] *4eme notte*—En parlant de jardins Mr. Franklin dit—*Comme ils sont bons à promener:* on a mis: *comme ils sont bons à la promenade*—il me semble que des jardins peuvent être bons à *promener*, puisqu'on juge qu'il sont bons à la *promenade*. Il y auroit encore plusieurs nottes a faire; mais comme elles servient toutes du meme genre; en voila assez pour démontrér que le Francois de Mr. Franklin est souvent aussi bon, toujours plus conçis que celui du sçavant qui le corrige; et—que les mots de sa création pourrient servir a enrichir notre langue.

M. F. Je ne peux pas bien repondre à cette question.

La G. Je repondrai donc pour vous, pas une fois.

M. F. Pas une fois!

La G. Pas une fois. Pendant tout le bel Été passé, vous y étez arrivé a six heures. Vous y avez trouvé cette charmante femme et ses beaux Enfans, & ses Amis, prêts a vous accompagner dans ces Promenades, [&] et de vous amuser avec leurs agréables Conversations. Et qu'avez vous fait? Vous vous étez assis sur la Terrasse, *vous avez* loué la belle Vue, regardé la Beauté des Jardins en bas; mais vous n'avez pas bougé un Pas pour descendre, y *vous* promener. Au contraire vous avez demandé du Thé et l'Echiquier. Et vous voila collé à votre Siege jusqu'à neuf Heures. Et cela après avoir joué peut être deux Heures où vous avez diné. Alors aulieu de retourner chez vous à Pied, [qui peut] *ce qui pourrait* vous remuer un peu, vous prenez votre Voiture. Quelle Sottise de croire qu'avec tout ce déreglement, on peut se conserver en Santé, sans moi.

M. F. A cette heure je suis convaincu de la Justesse de cette Remarque du Bon Homme Richard, que nos Dettes et nos péchés sont toujours [plus] *plus grands* qu'on ne pense.

La G. C'est comme [ca,] *cela* que vous autres Philosophes avez toujours les Maximes [du Sage] *des Sages* dans votre Bouche, pendant que votre Conduite est comme celle des Ignorans.

M. F. Mais faites vous un de mes Crimes *de ce que* que je retourne en Voiture de chez M^e^. Brillon.

La G. Oui assûrement, car vous quiavez été [ooo] assis toute la journée, Vous ne pouvez pas dire que vous étez fatigué du travail du Jour. Vous n'avez pas besoin donc d'être soulagé par une Voiture.

M. F. Que voulez vous donc que je fasse de ma Voiture?

La G. Brulez la, si vous voulez. Alors vous en tirez au moins pour une fois de la chaleur. Ou si cette Proposition ne vous plait pas, je vous en donnerai une autre. Regardez les Pauvres Paysans qui travaillent la terre dans les Vignes et les Champs autour des Villages de Passy, Auteuil, Chaillot, &c. Vous pouvez tous les jours, parmi ces bonnes creatures, trouver quatre ou cinq vieilles Femmes et vieux Hommes, courbés et peut être estropiés sous le poids des Années et par un travail *trop* fort et continuel, qui après une longue Journée de Fatigue ont à marcher peut être un ou deux Miles pour trouver leurs Chaumieres. Ordonnez à votre Cocher de les prendre et de les placer chez eux. Voilà une bonne Oeuvre! qui fera du bien [pour] *a* votre Ame; et si en même tems vous retournez de votre Visite chez les Brillons à Pied, cela sera bon pour votre Corps.

M. F. Ah! comme vous êtes ennuyeuse!

La G. Allons donc à notre Metier, il faut souvenir que je suis votre Medecin. Tenez.

M. F. Ohhh!—Quel Diable de Medecin!

monde a tort et a travérs et je sçais que ma petite machine en va bien plus mal : ce que je sçais fort bien *encore ;* c'est que la douleur devient quélquefois maitresse de la raison, et que la seule patience peut venir a bout de les deux chicaniéres ; j'en ai donc le plus que je puis, et vous conseille d'en faire autant mon ami ; lorsque les frimats ont attristes la terre, un beau soleil nous les faire oubliers : nous sommes au milieu des frimats, il faut patiément attendre ce beau soleil, et en l'attendant nous distraire dans les moments ou la foiblesse et la douleur nous laissent en repos ; voila mon chér papa ma logique a moi : | :

Votre dialogue m'a beaucoup amusé, mais votre *corrigeur* de françois a gasté votre besogne ; croyes moi, laissé vos ouvrages téls qu'ils sont, faittes des mots qui diront des choses et mocques vous des grammairiéns qui par pureté affoiblissent toutes vos phrases : si j'avois la teste asses forte je ferois une diatribe terrible contre ceux qui osent vous retoucher. Fut ce l'abbe de la roche, mon voisin veillard &c &c &c : je veux m'amusér a faire des nottes sur votre besogne et sur la leurs, [vous] et vous verres que c'est vous qui aures raison adieu mon bon papa, mon gros mari vous portera ma léttre, il est bien heureux de pouvoir vous allér voir, pour moi : il ne me réste que la faculté d'aimer mes amis, vous ne douttes surement pas que je ne m'en acquitte de mon mieux pour vous, jusqu'a la charité chetiénne c'est a dire votre charité chretiénne *éxclusivement :* | :—*The Franklin Papers, Vol. 43, No. 3.*

ce deux decembre.

Vottre lettre mon aimable papa m'a fait un sensible plaisir, mais si vous voulés m'en faire un plus grand restes en France jusqu'au moment ou vous verres ma sixiéme génération, je ne vous demande que quinze ou seize ans, ma petite fille sera mariable de bonne heure, elle est belle et forte : je goutte un nouveau sentiment mon bon papa auqu'el mon coeur se livre avec satisfaction, il est si doux d'aimer ! je n'ai jamais conçu comment il existoit des estres asses énnemis d'eux mesme pour repousser l'amitié ; il y a des ingrats, dira t'on ; eh bien l'on est trompé, cela est un peu dur quelquefois, mais on ne l'est pas toujours, et de se sentir incapable de le rendre donne un contentement de soi mesme qui consolle de la trahison :

Ma petite nourice est charmante et fraiche comme la rose du matin, l'enfant les premiers jours a eu de la peine a se faire a téter un sein ferme et donc le bout étoit mignon et court, mais la patience, le courage de la mére l'ont emporté, tout va bien, et rien n'est plus interessant que ce tableau, une jeune et jolie personne allaitant un superbe enfant, le père occupé sans cesse de ce spéctacle et joignant ses soins a ceux de sa fémme, mes yeux se mouillent sans cesse et mon coeur jouit mon aimable papa, vous sentés si bien le prix de tout ce qui tient a la belle et bonne nature que je vous devois ces details, ma fille me charge de ses remercimens et complimens pour vous, ma Cadétte, mes hommes vous

et de l'autre qu'elle varient sans cesse, ce qu'elle ne peut empêcher 'estre égalle, uniforme, c'est ma tendresse pour vous, que les tems, les lieux, les évenemens n'altereront jamais :

ma mére et toute ma famille se rapellent a votre souvenir :

j'ai eu de vos nouvélles par le voisin, mais il m'en faut absolument de vous :—*The Franklin Papers, Vol. 43, No. 33.*

ce mardi 16 a La thuillerie.

Je vous assure mon bon papa que je mettrai toute mon attention a ne pas trop donner *pour les sifflets ;* s'ils n'ont guérre couttés a ma bourse, ils ont couttés chérs a mon coeur et votre lettre me prouve bien plus encore que mon éxpérience et mes refléctions, que j'ai souvent payés bien chérs *de mauvais sifflets ;* j'ai cru par éxemple que lorsque j'aimois on devoit m'aimér, mesurant l'áme des autres a la mienne ; j'ai rarement trouvés la valeur de ce que je donnois, ce qui j'appelle *trop payér pour le sifflet ;* j'ai cru ce que les gents disoient, parcequ'ils le disoient ; et que je n'imaginois pas qu'on pû dire une chose lorsqu'on pensoit le contraire ; c'est de tous les siffléts celui qui m'a le plus coutté—je ne finirois pas si je faisois l'énumération de ce qu'il m'en coutte en sottises et en *sifflets ;* ce qui me consolle c'est que si j'ai été dupe, je n'en ai jamais fait ; j'ai desiré le bien j'ai aimé franchement et n'en veut point a mes semblables d'estre mechants : Le méchant doit éstre plaint, il ne peut étre heureux ! en mettant a part l'imagination et les erreurs qu'elle nous présentent sans cesse, en nous en rapportant a la phillosophie et a la raison, il n'éxiste qu'un seul moyen a l'homme d'estre heureux : qu'il soit bon — — — — — comment estre bon ? en n'agissant jamais que d'aprés son coeur—en se demandant toujours avant de faire une action si elle est juste—en choissisant bien des amis en respectant les loix, les usages du pays qu'on habitte ; en tachant de voir juste dans tous les points possibles, de se depouiller de tous préjugés, de toutes préventions, sans heurter pour cela l'oppinion des autres ; en sâchant s'occuper utillement dans son état, en en remplissant les devoirs ; en faisant enfin ce qu'a toujours fait mon bon papa, qui n'a trop payé le sifflét qu'étant tout enfant et qui depuis ce tems a plaint tous ceux qui les payoient au dela de leur valeur :

de samedi en huit mon bon papa, je vous donnerai un peu de musique, quelques parties d'échécs, et du thé ; je compte revenir le jeudi vingt cinq de ce mois pour disner : vous dirais je que j'aurai bien du plaisir a vous revoir ! non ! j'aime mieux vous le laisser dévinér—la seule chose que je veuille vous dire sur cet article, c'est que vous pouvés croire que personne au monde ne vous est plus sincérement attaché que moi, et que vous pouvés m'aimer en conséquence sans craindre de trop donner *pour le sifflét :*

Mr Brillon a bien ri des *sifflets :* nous trouvons que ce que vous

appelés votre mauvais françois, donne souvent du picquant a votre narration, par la construction de certaines phrases, et par les mots que vous inventés: m^r^ Brillon, mes enfants, ma mére, mon frére vous présentent leurs hommages et amitiés; nous faisons tous avec votre pérmission mil compliments a m^r^ votre fils:—*The Franklin Papers, Vol. 43, No. 34.*

ce 11 x ^bre^ à nice.

Mon chér papa le voisin vous remettra ce petit mot; sçavés vous pourqu'oi je ne vous écris qu'un petit mot bien petit c'est que je vous boude—oui monsieur papa je vous boude: comment! vous prenés des armées entiéres en amérique, vous *burgoinisés* cornwallis, vous prenés canons, vaisseaux, munitions, hommes, cheveaux & & vous prenes tout et de tout, et la gasette seule l'apprend a vos amis qui se grisent en buvant a votre santé, a celle de Wasington de l'independance, du roy de france, du marquis de la fayette, de M^r^ de Rochambault, chalelux & & tandis que vous ne leurs donnés pas signe de vie; vous devés cependant estre un bon vivant a présent, quoique cela vous manque rarement, vous estes surement rajeuni de 20 ans par cette bonne nouvélle qui doit nous amener une paix durable a la suitte d'une guérre glorieuse—je vous boude donc et vous bouderai jusqu'a ce que j'aye de vos nouvelles; en attendant cependant comme je ne veux pas la mort du pêcheur je vous ferai une marche triomphalle, je vous l'envoyerai, vous eçrirai, et vous aimerai mesme de tout mon coeur: | :

POSTSCRIPT BY M. BRILLON.

Moy qui ne vous boudes point, je vous fais mon compliment bien sincere mon cher Papa et vous embresses des deux cotés bien cordialement, aussi le petit fils que je ne puis separer de vous.

FRANKLIN'S ANSWER.

a PASSY, ce 25 Dec^r^, '81.

Vous me boudes, ma chere Amie, que je n'avois pas *vous* envoyé [un expres pour vous avertir de] *tout de suite l'histoire de* notre grande Victoire. Je suis bien sensible de la Magnitude de notre Avantage, *possibles bonnes* et de ses Consequences; [probables possibles,] mais je ne triomphe pas. Sçachant que la Guerre est plein de [Evenements] *Varieté* & d'Incertitudes; dans la m*au*vaise Fortune j'espere la bonne; & dans la bonne je crains la mauvaise. Ainsi je joue à ce Jeu avec presque la meme Egalité [de l'] Ame que [vous que] vous m'avez vú [je] jouer aux Echecs. Vous sçavez que je ne renonce jamais à une Partie avant qu'il est finie, esperant toujours de gagner, ou au moins d'avoir un Pat & je me g[u]arde, quand j'ai bonne Partie, contre la Presomption, qui est souvent trés nuisible, & toujours trés dangereuse. Et [si

j'avois] *quand j'ai* de Presomption je tache de le [cacher] cacher, pour eviter la Honte si la Fortune change. Vous voyez pourquoi j'ai dit si peu de cette Affaire, & que j'ai seulement remarqué, que rien ne pouvait me faire parfaitement heureux; en certain Circonstances.

Comme vous avez toujours evité de faire des connoissances nombreuses, vous ne pouvez pas imaginer le Quantité de Gens qui s'interessent de votre Bienétre. Je [trouve] *rencontre* toujours quelques uns en toutes les [Compagnies] *Societés*, en toutes les Parties de Paris & a Versailles, qui me demandent de vos Nouvelles, de votre Santé, *a bout que vous etablirez votre Santé, que vous vivrez long tems ameliorez votre constitution que vos nerfs seront fortifies*, & ceux qui m'aiment disent quelques mots pour me consoler de Votre Absence: tous parlent de vous avec Respect *plusieurs avec affection* & *meme* avec Admiration. Cela est Musique pour mes Oreilles & plusque compense [la] *ma* perte des Noels charmantes, que la Saison me fait souvenir.

Je passe souvent devant la Maison. Elle me paroit desolée. Autrefois j'ai brisé le Commandement en la Convoitant, avec la Femme [& les Enfants] de mon [bon] Voisin. A cette heure je ne [la] le convoite plus. Ainsi je suis moins Pecheur. Mais par Rapport a la Femme, je trouve toujours [cette Espece de] *ces* Commandements [being] bien incommodes, & je suis faché qu'on *s'est avisé* [a] de les faire. Si [vous] dans vos voyages vous vous trouvez chez le Saint Pere, demandez de lui de les rapeller, comme étant données seulement aux Juifs, & trop genantes pour les bons chrétiens.

Voila arrivé le Jour de la Naissance du Dauphin du Ciel, & jusqu'a present nous n'avions eu la moindre Apparence d'Hyver. J'ai diné aujourdhuy à Chaillot les Portes & Fenetres ouvertes comme en Éte & J'ai dit a moi-meme, je ne crois pas qu'on a plus beaux temps à Nice, [& j'etois pret a chanter] *& j'etois pret a chanter.*

Helas! pourquoi chercher [si loin] sur l'onde la Bonheur qu'on trouvoit [chez soi] au port. Mais j'espere que tout sera pour le mieux.

Quoique j'ai dit que je ne triomphe pas, je serai bien aise d'avoir la Marche que vous avez la bonté de me promettre. Mais je crois que je ne l'entendrai bien jouée avant votre retour.

J'ai lu la petite Memoire de votre Ami de Marseilles. [Il est] Elle est plein d'Intelligence & de bon Sens. Je la communiquerai ou elle peut avoir quelque bonne Effet.

Dites quelques millions de bonnes choses pour moi [n] a chacun & chacune de votre heureuse [Compag] Societé.—*The Franklin Papers, Vol. 43, No. 44.*

ce dimanche 26.

Voici mon bon papa des nottes sur votre charmant dialogue, j'ai voulu prouvér que vous disies mieux que tout autre, mesme dans une

langue que vous ne sçavéz qu'imparfaittement: quelques puristes pourroient nous chicaner, parceque ces éspéces d'animeaux pésent les mots a l'alembic d'une froide érudition; moi qui ne les pésent, n'y ne les comparent; animal fémmélle que l' instinct du sentiment guide comme vous me paroisses vous énoncer plus énérgiquement plus fortement qu'un gramairien, ma sensibillité juge pour vous, contre tous les sçavants passés, présents, et futurs: adieu mon ami, je pourrois peut estre avéc mon instinct faire de longues dissertations pour appuyér mon opinion et peut estre mes raisonnements, ne seroient pas plus déraisonnables que ceux de la pluparts de nos admirables, illustres; —Encyclopédistes, Economistes, moralistes, journalistes, théologiens, athées, materialistes et Sçavants en tous les *istes* possibles? Mais il n'y a pour moi qu'une chose importante a vous prouvér; c'est que personne au monde ne vous aime plus tendrement et d'une maniére plus vrai que moi: | :

je vous demande mon ami une copie du dialogue que je vous renvoye, vos ouvrages en tout genre me sont prétieux, et je n'oublie pas la promesse que vous m'avés faittes de me donnér vos oeuvres imprimées que j'aurois déja s'il ne m'étoit plus doux de les tenirs de vous: | :

ce samedi 25.

J'envoye sçavoir de vos nouvélles mon bon papa; lés miénnes sont meilleures mais je suis encore loin du but: je comptois vous envoyér mes nottes; des amis ont pris le tems que je vous résérvois en venant causér avéc moi; ils ne m'ont point empêcher de penser a vous et de vous aimér, nulle puissance n'en viendroit a bout! mais je n'ai pú vous ecrire: adieu mon bon ami, a nous deux nous ne ferions pas deux instruments a bonne et mauvaises jambes, car j'ai bien peur que nos quatres n'en valent pas une médiocre.—*The Franklin Papers, Vol. 43, No. 77.*

Exercise in French, N. 5.

Letter to M^e^ B., transcrib'd and corrected by her (in Franklin's handwriting).

Depuis que vous m'aves assuré que nous nous rencontrons *rencontrerons* et que nous nous reconnoitrons en paradis, j'ai pensé continuellement sur l'arrangement de nos affaires dans ce pays lá; car j ai grand *grande* confiance en vos assurances, et je crois implicitement ce que vous croyés:

Vraisemblablement plus que *de* 40 années couleroient *couleront* aprés mon arrivée lá, avant que vous me suiveres *suiviés:* je crains, un peu, que dans la course d'une *d'un* si longue *long* temps, vous pouvés *ne puissiés* m'oubliér. c'est pourqu'oi j'ai eu la pensée de vous proposer de me donnér votre parole d'honneur, de ne pas renouveller lá votre contrat avec M^r^ B.—je vous donnent au *donnerai en*

mesme temps le mien *la mienne* de vous attendre mais ce monsieur est si bon, si génereux envers nous—il vous aime—et nous lui—si bien —que je ne puis [pas] penser [de] *a* cette proposition, sans quelque[s] [scrupules de] scrupule[s] de conscience — cependantl'idée d'une Eternité dans laquelle je ne serai pas plus favorisé que d'estre permis *d'avoir permission* de baiser vos mains, ou vos jouës quelquefois, et que de passér deux ou trois heures dans votre douce société les soirées des mercredis et samedis, c'est effroyable : enfin je ne puis pas faire cette proposition, mais comme (avec tous ceux qui vous connoissent) je souhaitte de vous voir heureuse en toutes choses, nous pouvons agréer de n'en plus parlér a present et de la laisser a vous, *vous laisser la liberté d'en decider*, quand nous [*tous*] nous rencontrerons tous : lá d'en determiner comme vous jugerés le meilleur pour [la] vostre félicité et pour les nôtres. determines comme vous voudres, je sens que je vous aimera *aimerai* eternellement—si vous me rejetteres *rejettés*, peut estre je m'addresserai *m'addresseraije* a m^de^ D'hardancourt, et qui il *a qui il* plaira [peut estre a elle] de faire menage avec moi ; alors je passerai mes heures domestiques agréablement avéc elle ; et je serai plus a portée de vous voir, j'aurai asses de tems dans ces 40 années la, de pratiquer sur L'Armonica, et peut estre je jouerai assés bien pour estre digne d'accompagner votre forté piano, nous aurons de tems en tems de petits concerts : le bon pére pagin sera de la partie, votre voisin et sa chere famille [m^r^ jupin] *m^r^ de chaumont*, m^r^ B, m^r^ jourdon, m^r^ grammont, m^de^ du tartre, la petite mére, et d'autres amis choisis seroient *seront* notre auditoire, et les chéres bonnes filles accompagnées par quelques autres jeunes anges de qui vous m'avés déja donné les portraits, chanteroient *chanteront* avéc nous le alleluia, nous mangerons ensemble des pommes de paradis roties avéc du beure et de la muscade ; et nous aurons pitié de ceux qui ne sont *seront* pas morts :

Notes by Franklin.

More than 40 years—Plus de (not que) 40 années.
To think of a thing—Penser à (not de) une chose.
To be permitted—D'avoir Permission (not d'être permis).
Perhaps I shall address myself—Peutêtre m'addresserai-je (not je m'addresserai).—*The Franklin Papers, Vol. 43, No. 87.*

Bravo, Bravissimo, la lettre pour m^r^ de parseval ; il n'y a rien a corriger, et m^r^ franklinét ne me l'a envoyé que par excés d'amour propre ; m^r^ de parseval demeure rue s^te^ anne, m^r^ franklin le verra ce soir chez m^r^ de floissac ; adieu, avant qu'il soit nuit nous nous verrons en attendant pourtant j'embrasse mon papa : et je saluë le petit fils.—*The Franklin Papers, Vol. 43, No. 98.*

Plaidoyer pour Madame
Brillon de Joury
francaise native de Paris demeurant
ordinairement à Passy de present à Nice

Contre Monsieur
Benjamin Franklin
américain né à Boston ci devant
academicien, phisicien, Logicien & & &ca
aujourdhui Ambassadeur en France des
Provinces unies de L'amerique resident
à Passy.

C'est avec regret que Le Sanctuaire de la Justice S'ouvre et que cette deesse ecoute des plaintes portées contre un homme celebre, que ses ennemis mêmes ont respecte comme le plus sage, et le plus juste des philosophes de son Siecle; Sa Partie adverse même Longtems abusée sur son merite, n'osoit reclamer une dette qu'elle croyait d'autant plus sacrée qu'elle regardait comme inutile La Signature de Monseigneur Benjamin Franklin, et que sa parole lui paraissait plus sure que tous les contrats: aujourdhuy Lesée dans tous ses droits, opprimée sous le poids de L'injustice, elle craindrait peut être encore de ternir la reputation de L'homme qui La trompé de la maniere La plus outrageante, si la Societé n'était interessée á devoiler un crime d'autant plus atroce, et dangereux à Son repos, qu'il est commit par un homme en place dont L'état & la reputation semble lui assurer L'impunité.

O Justice, ô deese image du dieu, qui regit L'univers, qui devoile les actions Les plus cachées pour recompenser la vertu ignorée, et punir Le vice orgueilleux qui leve sa tête altiere se croyant a L'abri de la Foudre, Justice, je t'implore en Faveur de la Dame Brillon, pese dans tes balances redoutables les conventions reciproques de L'ambassadeur, et de la Femme qu'il abusa d'une maniere cruelle, ne te laisses seduire ni par L'eloquence Sublime de l'amériquain coupable, ni par sa Science dangereuse, ni par sa reputation que la renommée s'est enorgueillie d'étendre d'un pôle à L'autre, plus le coupable est grand, plus il cause L'admiration des deux hemispheres, plus ta gloire s'accroitra, deesse, en proportionant La punition à L'offense en Laissant tomber ton tonnere sur celui qu'on assure avoir enchainé La Foudre, comme il entraina tous Les Cœurs.

Faits.

En 1776 Messire Benjamin Franklin fit une societé d'amitié conjointement avec La dame Brillon, par La quelle ils se promirent reciproquement de se voir souvent Lorsqu'ils seroient à portée de le faire sans prejudicier à Leurs affaires reciproques.

2° de s'ecrire Lorsqu'ils seroient separés.

3° de repondre exactement à toutes les lettres ecrittes par L'un où par L'autre.

4° de n'alleguer aucunes raisons pour se dispenser des conventions cy dessus enoncées.

En 1781 Madame Brillon obligée de faire un long Voyage pour cause de Santé, prit congé de Monsieur Benjamin Franklin avec une veritable douleur, il parut touché de son depart Lui rapella Leurs conventions, Lui ecrivit à sa premiere Station en lui faisant de nouveaux Serments ; Madame Brillon croyant d'après cette premiere demarche que sa dette etait assurée, ecrivit souvent à L'ambassadeur, il repondit d'abord, ensuitte Les reponses S'eloignerent, ensuitte il ne fit plus aucunes reponses aux Lettres de Madame Brillon, et n'en fit même Qu'une très courte au placet Le plus touchant que cette dame et sa famille Lui addresserent dans leur detresse, La Dame Brillon apprit dans ce tems par Monsieur Le Veillard dont le temoignage peut faire foi, que ce n'etoit pas fautte de tems de la part du dit Benjamin puisqu'il avoit le Loisir de courtiser au moins deux Jolies femmes par jour dans ses moments de disette ; elle pria Monsieur Le Veillard de lui rappeller ce qu'il lui devoit et de L'engager à suspendre ses galanteries un quart d'heure tous Les quinze jours et payer petit à petit Les arerages du Fonds qu'il doit à Madame Brillon, Le dit Benjamin s'avoua coupable, mais ne paya rien ; La Dame Brillon poussée à bout par La recidive des torts de son adversaire s'est determinée à se pourvoir devant vous A ces Causes requiert La Suppliante que le dit Messire Benjamin Franklin soit condamné envers elle à tous depens, dommages, et interets qu'il vous plaira fixer relativement aux Faits exposés.

Nous : oui m^e^ D'orengo, pour la dame Brillon, et Maitre Condu nommé d'office pour Messire Franklin ; Le quel nous a demandé du tems pour avoir des instructions de sa partie, leur avons donné acte de leurs dires et requisitions, ce faisant avons accordé un moi de delay à La partie de M^e^ Condu, et cependant attendu que les plaintes faittes par la partie d'orengo nous paraissent infiniment justes et Equitables, condamnons provisoirement Le dit Franklin à ecrire dans Les vingt quatre heures de la significations du present arrêt une premiere Lettre Longue, où il demandera de L'indulgence pour ses fautes passées, et six Lettres plus courtes (Les sujets à son choix) et pour les quelles lui accordons six mois depens reservés.

A Nice Le 20 Mars 1782. Signés Le Comte de Marié premier president, Le Comte trinquiery de St. Antonin 2^e^ president, Langosco, d' Oresti, Reynardy, reyberti, roubiony, Bataglini, maccarani, Leotardy, Caravadosy, Senateurs. Collationé Conforme à l'original.

Crespeaux de Piscatory Greffrez.

—*The Franklin Papers, Vol. 43, No.* 116.

Voici, ma trés cher Amie, une de mes Plaisanteries serieuses, ou sourdes, que je vous envoie, esperant qu'elle pourra peutétre vous amuser un peu.

DOVER, Saturday 28, Aug^st^, 1784.

Dear & Hon^d^: Sir

After a very disagreeable Passage, which lasted from 8 last Night to 8 this Morning, we arrived here safe. I was sick the whole Passage—I think more so than in either going or returning from America. Mais comme en toutes Choses, "il faut toujours regarder *la Belle Jambe*,"—I flatter myself with the Notion that it will prove a *Crise salutaire*, as Mesmers stiles it;—& which *you* Doctors have decided *as fatale*, or very near it. Etc.

With the sincerest affection and Gratitude, I am ever, Hon^d^ Sir,

Your dutiful Grandson

W. T. FRANKLIN.

The Franklin Papers, Vol. 32, No. 95.

LONDON, 12. Oct. 1784.

Dear & Hon^d^ Sir:

——— I gave M^rs^ Sargent several pieces of your Writing, who was infinitely pleased with them, & thinks the Dialogue with Mad^e^ la Goute, ought to be publish'd for the Benefit of Mankind. Etc.

Your most dutiful & affect^e^ Grandson

W. T. FRANKLIN.

The Franklin Papers, Vol. 32, No. 133.

——— Accept my thanks for the pieces you sent me. everything written by you is valuable to me. I have lately had the good fortune to meet with a pretty good likeness of you in profile, done at Paris.

With every sentiment of gratitude & respect,

I have the honor to be

Most Dear Sir

Your Obliged & affectionate Humble Serv^t^

AMELIA BARRY.

PISA, 10th Dec^r^, 1784.

The Franklin Papers, Vol. 32, No. 202.

CHILBOLTON, Nov^r^ 13th, 1786.

——— I have particularly to thank you for "The art of procuring pleasant Dreams" indeed it flatter'd me exceedingly that you should employ so much of your precious time in complying with my request, but where do you read that Methusalah slept in the open air? I have searched the Bible in vain to find it. Etc.

Affectionately yours,

C. L. SHIPLEY.

The Franklin Papers, Vol. 34, No. 167.

Count sarsfield hoped to receive to-day the collection of some of those little pieces which mr. franklin had promised to him & which he had forgot yesterday.

he cannot help writing again about them to mr. franklin. he is so much the more impatient of receiving them that he is very near his departure for the Hague he desires mr. franklin never to forget his most sincere and devoted attachment.

friday ye 5th at night.

The Franklin Papers, Vol. 43, No. 232.

ANECDOTE.

The intended speech for the opening of the first Session of the present Parliament viz. Nov^{r} 29, 1774.

My Lords and Gentlemen:

It gives me much concern that I am obliged at the opening of this Parliament to inform you that none of the measures w^{ch} I adopted upon the advice of my late Parl^{t} in respect to the disturbances of my American colonies have produced those salutary effects, w^{ch} relying upon the supposed wisdom of their deliberations I had been induced to expect. I therefore sent that Parl^{t} apacking rather abruptly, & have called you in their place to pick a little advice out of your wise heads upon some matters of the greatest weight & importance relating to a sort of Crusade that I have upon my hands. I must needs tell you that the business if you choose to undertake it for me will be a seven or ten years job at least. You must know then that my ministers have put me upon a project to undertake the reduction of the whole continent of North America to unconditional submission. They w^{d} have persuaded me to coax you into this project by representing it to you as a matter very easily to be done in a twinkling, and to make you believe that my subjects in America whom you have always hitherto considered as brave men are no better than a wretched pack of cowardly run a ways, & that 500 men with whips w^{d} make them all dance to the tune of Yankey Doodle; but I w^{d} tell you no such thing because I am very sure if you meddle with it that you will find it a very different sort of business.

Now Gentlemen of the House of Commons I give you this fair notice for yourselves & your Constituents. If you undertake this job, it will cost you at the least farthing a good round sum of 40 or 50 millions; 40 or 50 thousands of your Constituents will get knocked on the head and then you are to consider what the rest of you will be gainers by the bargain even if you succeed. The trade of a ruined & desolated Country is always inconsiderable, its revenues trifling; the expence of subjecting & retaining it in subjection certain & inevitable. On the other side sh^{d} you prove unsuccessfull, sh^{d} that connexion w^{ch} we wish most ardently to maintain be dissolved, sh^{d} my ministers exhaust

your treasures & waste the blood of your Countrymen in vain will they not deliver you weak & defenceless to your natural enemies.

You must know this is not the first time that the Serpent has been whispering into my ear, Tax America. Cost what it will, make them your heavers of wood & drawers of water. Let them feel that your little finger is thicker than the loins of all your ancestors. But I was wiser than all that, I sent to L^d^ Rockingham & the advice that he gave me was this, not to burn my fingers in the business, that it was ten to one against our making any hand of it at all, that they were not worth shearing & at best that we sh^d^ raise a cursed outcry & get but little wool. I shall remember his last advice to me as long as I live. Speak good words to them and they will be thy servants for ever.

And now my Lords and Gentlemen

I have stated the whole matter fairly & squarely before you. It is your own business, and if you are not content as you are, look to the rest for yourselves. But if I were to give you a word of advice it should be to remind you of the Italian epitaph upon a poor fool that kill'd himself with quacking

Stava ben, por star meglio, sto qui.

that is to say. I was well, I would be better, I took Physick and died.

UNSIGNED.

Marked on the reverse side of the last sheet:

D. Hartley.

October 3, '86.

The Franklin Papers, Vol. 44, No. 12.

My dearest sir:

I am sure I shall tell you something which you will have no pleasure in repeating again, when I inform you that L^d^ Chatham is very ill indeed. Alarming symptoms have appeared, and no likelyhood of his getting rid of them, as he grows weaker every day. This intelligence is fresh from Hayes, where he now is. As I am *afraid* this great man is dying, I think it proper to give you what I recollected in his short speech on the 7th of April; for short it was, and appeared as the mere throwing down of the gauntlet; reserving himself wholly for reply to the Duke of Richmond. He said, he

"Was ill, but glad he was not in his grave when he heard of giving independence. The counsel dastardly and pusillanimous. Was there no middle way? Could not be said, while country ruined by unretracted error. Was not then for making a rod to —— whip our own backs.

"Would never put his hands to the back of bonds for signing away America; or call princes to the Committee. America their birthright: it was once here: under a prince of house of Brunswick, how came it gone? Feared there was something *rotten* near the throne; yet did not mean ministers places.

"Our case bad enough, but wished he could see daylight in the proposition. France had taken our trade our fairest flower, and it was saying to France; insult us, take all we have, but don't make war with us. Did not indeed know the means [had such as we had, we must use them]: but if we must die, would die decently. Had stood irruptions of Danes and of Normans, of Armada & Scotch rebels. Would not then extinguish and put out the glories of that throne (pointing to it).

"Knew he should be favorably interpreted:—whatever else he was thought, should be thought sincere."

These are all the expressions that have occurred to me; and if a variation was observed by others, I have inserted it. I suppose you know that the debate-writers for the newspapers are seldom very exact: Indeed they are low people, hear indistinctly, and know neither the history of men, parties, or *opinions;* and therefore are always blundering. As to the order of sentences it cannot be expected that I should preserve it, but I have reported as faithfully as I could. His voice was often low and did not then reach the bar. The Duke of Richmond (who by the by is greatly improved, and will make a remarkable figure in this country, having much English stuff in him, and though not a soaring mind, yet very capable of business and detail, which he will conduct with industry, honor & courage), the Duke of Richmond I say, spoke pretty well in reply, but it was rather commonplace, and what had chiefly fallen from him in former debates. There was a little harshness & sternness in it, which he cannot always keep under even to his domestics, but on the whole it was neither bitter nor formidable. I had observed Lord Chatham shifting his crutch from one hand into the other once or twice, but did not observe that he made any exertion to get any thing out of his pocket, which they tell me was the case (feeling for a handkerchief with a tug;) but on a sudden he disappeared, and was carried out of the house without sense, and like a corpse; and did not recover for almost an hour. He looked very ill at coming in at first; but did not speak so feebly as on the 30th of May, 1777, when he told L^d^ S—— to be prepared for the worst, for he did not know what might happen. In July or August last he fell off his horse in a fit, but recovered so as to go through much business in the beginning of the sessions. I think about fifteen or twenty voices cried out after the bustle was over, go on, go on; at which I was hurt; and they *told me* the Duke of Richmond spoke of being obliged to attend his militia; which is possible enough. When L^d^ Chatham was told by D^r^ Addington, that the Rockinghams said, the Duke of Richmond had killed him: "Another time," said Lord Chatham, sternly and firmly.

April 8th: L^d^ Shelburne came to the house and resumed the debate; and made a prodigious impression upon the Duke of Richmond; who

really spoke his heart in the compliments he paid; and certainly it was a prodigious speech. Some trick and play there was in it; or as the Duke of R. called them "the honest arts of eloquence, for they were honest, he said;" but on the whole a monstrous deal of comprehension, reading, and real solid eloquence; too rapid and sudden however to be always neat and without expletives. I shall trouble you with none of it except what is material to you as an American and negotiator, and to save him from mis-interpretation, which has been more ignorantly than industriously used, though some of the latter kind has taken place in the *abuse* brought against him.

"Man creature of regulation; is what his government makes him. A declaration of independence would acquit America of thinking as English men; would make separate interests, competition and hatred. Already asked for Canada, Florida and Scotia; and then to follow fishery and islands. Much property lost by it to individuals. A vast weapon put into hands of congress; soon make minority into majority. Would now give it *for nothing;* for nothing said in return to the offer, but that they won't thank you for it. Not a child's play with diadems, to toss away a diadem, and hope to have it back again improved. Many of congress-men wished to serve their community; those of elevated minds would wish (as they ought) to have elevated stations. Was sure, however, the union would be again; and the name of Englishmen last, when that of France was rotten. France meant to dupe one and hurt both. Now thirteen republics; republics peaceful: would pay their first quotas easily, as in the scrip, but third and fourth payments would drag heavily. Prince Maurice built a citadel at Groningen to inforce payment of quotas. (There he said something about an agrarian law being as natural to a republic, as entails to a monarchy; but I forget the application.)

"Wished none of the commissioners sent: if sent, sent with view to be refused. Ought to do like bungling physicians: after trying many things, try nothing; see what nature would do, nature enough in this case. Leave them alone: they will soon find what they have lost, and in two or three years be for sending commissioners here.

"As to France & Spain most all despair: England had her same people, same private wealth, if properly taken care of and confidence to draw it forth from its hoardings. If we grown old, France grown old too. France & Spain vulnerable.

"Though lords despond, those who know frivolousness of French won't despond, not women even, who do know it. France had great individuals, so had falling Rome; but nation refined in nothing but in the art of making court: This the view of all.

"Rupture with France not instant; long seen; why then surprised; why not so before? Had low spirits at times himself; men in despond-

ence he knew had not right judgments. We must appeal to the public; call out religion and freedom; give men something to fight for; (The present a war of slavery) and follow a directing public.

"In 1672 Holland in a worse state; & offered to submit to Lewis, and only Amsterdam firm. De Witz, like all other great men failed in not knowing the extent of folly; never thought Charles would let them go; yet Charles did. But still De Witz's maxim was, no country ought ever to give up one point of justice or reason, but oppose it from first. De Witz not only said, but did; visited the fleet, made infinite exertions, and was torn in pieces repeating the ode

"Justum and tenacem propositi etc.

"Not true that Philip and Elizabeth accomodated to each other. As fast as one assisted Holland, the other assisted Ireland; and Armada was *forced* to delay, because Walsingham, Gresham & Sutton borrowed Genoese bank money that was to arm it. Here was stock-jobbing, and yet cost only 40,000. Wished these times produced a Walsingham, and merchants like Gresham. Yet still some spirit to his knowledge and did not speak of mountains and mice.

"If this point given up, should be ashamed of London, still more of abroad; believed should retire to the country. If danger followed him, would do as a traveller would, who found himself at a tavern where a company of gentlemen were attacked by ruffians; without interest, would take his share.

"But am asked a question: Must we fight all three? Will answer distinctly; think need only fight two of them; but if necessary, yes, fight the three.

"On the whole, wished not to be replied to on the spot; begged them (the Buckinghams) to take time, and weigh. He knew their worth. His opinions not court opinions: but respected their unspotted characters and hoped *their* good intentions would not aid the little cunning of others to ruin the country. Should unite against ministers: Not to reap seed of *their* sowing, but have reaping of seed of their own sowing.

Then followed a great variety of other matters relative to ministry and their conduct.

He spoke two hours, besides a reply; and was not flat for a moment. In his beginnings he is often flat, for 5 or 6 minutes, though *wonderfully* improved.

He explained the expression of Lord Chatham's not knowing the means. But I wonder the Duke of R. did not talk of the instance of irruptions by Danes and Normans, as contrary to the case to be proved. Indeed the Danes were finally repelled and Norman line compromised, and in each case the Kings were obliged to reside in their conquests; but the instances certainly very awkward.

No news that I can communicate. The King and Queen will be at

Portsmouth on Friday. The Irish bills of course will not pass, ministry not being with them. Gov^r. Johnstone had great hopes at going out, but they have just heard here that America is not much inclined to negotiation, they say. I think they tell us W. Hartley makes the 20th ambassador you have had. I am very glad the first time I saw my friend, that I had *no* connections; and the second time that I scarcely shewed an inclination to *hear* what, if I had been sent by my connections, I *ought* to have heard.

I think if Lord Chatham had remained well, that a change of ministers would not have been distant; for they know that he minds measures more than men, and rather has a turn to take care of national grandeur than national liberty, farther than as the latter assists the former; all which is in a great degree true. Under him therefore they thought they could pension their creatures with sinecure places, leaving him the general direction.

Upon a conversation this morning with Col. B., I find that absentees will at first be just as safe as inhabitants, personal care and exertion excepted, and therefore content myself with getting a letter to *our* governor, strongly desiring him to recommend our property to protection of the conqueror, which recommendation he knows by experience will be attended to. But as I wish to have two securities where I think them possible, I shall beg the favor of you to get the same thing mentioned to the parties concerned on your side, if you think it proper; but as you may not think it proper, to make the refusal easy and to prevent improper communication being expected I hope you will never mention to me in *any* way, the part you may take. Our parish is that of St. James: I have a brother named Charles on the spot. As to our connections, they are rank whig and American. I know you have nobleness enough to excuse this application; and consider it as not made wholly on my part, but for the family. I am as ever, my dearest sir, your most devoted, affectionate and grateful — — —

D^r. P. & D^r. P^s.
have had a correspondence
upon the latter's metaphysical
writings, which will probably be
soon published, unless the distraction of the times
should withdraw attention to such subjects
I have had some papers for the Duke De [Piece torn out of the paper.]
by me, but they are still in their old state, and I
have not had leisure to prepare them for him.—
April 28, 1778.

I dare say you have many such voluminous correspondents as myself: but you see how my pen runs to you.—*The Franklin Papers, Vol. 9, No. 93.*

Franklin's Bagatelles.

The American Philosophical Society is the owner of seventy-six folio volumes of the papers of Benjamin Franklin. Franklin by his will left all his books, manuscripts and papers to his grandson, William Temple Franklin. Bigelow, in his *Life of Franklin*, prints the will (Vol. 3, p. 476) and (p. 466) a letter from William Temple Franklin, dated Philadelphia, May 22, 1790, to M. Le Veillard, of Paris, the intimate friend of Franklin, advising him of his grandfather's bequest. Later Temple Franklin returned to Europe, living in London and Paris, and dying in London in 1823, and by his will leaving to his friend, Charles Fox, of Philadelphia, all the Franklin papers in this country. These papers had been for many years stored in the barn at Mr. Fox's country seat at Champlost, near Philadelphia. His son presented them to the Philosophical Society some sixty years ago, and here they have been kept ever since.

Many of them were bound up in a pretty rough way, each volume prefaced with a rough alphabetical reference list; many of them were left in the original packages, bundles with little other than a crude chronological order, until quite recently our librarian, Dr. Hays, had them mounted and bound and lettered. Little systematic use has been made of them, but now it is proposed to calendar them, and to print these calendars, as the Lee, Weedon and Greene papers of this Society have been printed by the Society, so that students may know what they contain, and be able to refer to them directly or through the very competent staff of the Library of this Society. To their aid is due the examination of them for traces of the "Bagatelles," written by Franklin and printed on his press at Passy, and I submit these rough notes as showing the variety, extent and importance of this collection. William Temple Franklin printed in the fifth volume of his grandfather's works (second edition, London: Colburn, 1819), in the second volume of the *Posthumous and Other Writings*, under the head of "Bagatelles" (Sec. 3, pp. 216 to 298), the following headnote: "The letters, essays, etc., contained in this section were chiefly written by Dr. Franklin for the amusement of his intimate society in London and Paris, and were by himself actually collected in a small portfolio, endorsed as above. Several of the pieces were either originally written in French, or afterwards translated by him into that language by way of exercise." Then follow:

1. The Levee.

2. Proposed New Version of the Bible.

3. Apologue (written, says a footnote, at the period of and in allusion to the claims of the American Royalists on the British Government).

4. To Miss Georgianna Shipley, dated London, September 26, 1772, with an epitaph on her American squirrel.

5. The Art of Procuring Pleasant Dreams.

6. The Ephemera, an Emblem of Human Life (written in 1778, to Mme. Brillon, of Passy).

7. The Whistle (to Mme. Brillon, Passy, November 10, 1779).

8. The Petition of the Left Hand.

9. The Handsome and Deformed Leg.

10. Morals of Chess.

11. Conte (with a translation), a Tale.

12. Dialogue between Franklin and the Gout (dated midnight, October 22, 1780).

13. To Mme. Helvetius, at Auteuil.

14. À Madame Helvetius (in French, with a translation into English).

15. Très humble Requete Présentée a Madame Helvétius par ses Chats (with translation).

16. À M. L'Abbé de la Roch, à Auteuil (with translation).

17. À M. L'Abbé Morellet, Passy (with translation).

In Vol. 1, p. 410, of *The Memoirs of the Life and Writings of Franklin*, Philadelphia, 1818, published by William Duane, is the following from the Introduction to the *Life and Works*, by his grandson, William Temple Franklin: "Notwithstanding Dr. Franklin's various and important occupations, he occasionally amused himself in composing and printing, by means of a small set of types and a press he had in his house, several of his light essays, 'Bagatelles,' or jeux d'esprit, written chiefly for the amusement of his intimate friends." Among these were the supplement to the *Boston Chronicle* of March 17, 1782, which is reprinted; Franklin, in his letter dated Passy, July 7, 1782, enclosed a copy to his friend Mr. Hutton in London. Clearly Franklin took care that his political satires should be read far beyond the circle of his friends in Paris, and they were spread broadcast in the newspapers.

Ford, in the Introduction to his Franklin Bibliography, says: "Sent in 1776 by the Congress to France, his pen was soon at

work, not merely on the routine addresses, memorials and letters intended to persuade the French Government or inform that at home, but in satires on the English methods of conducting the war, use of the Indians, Hessians, etc.; in exposing the financial straits and impending ruin of that country, and in urging the advantage of loans to America; while there is good authority for ascribing to him the partial editing of a periodical which was intended to influence the French people in favor of the American cause, and prepare them for the treaties of amity and alliance to which Franklin eventually set his name. It was during his nine years' service in France that he also wrote most of what have been since known as the 'Bagatelles'—little essays on many subjects, composed for the amusement of 'la société choisie de Franklin.' They were written in his happiest vein, fifteen or twenty copies printed on his private press at his home in Passy for the little circle for whom they were intended." A little later Mr. Ford says: "The writings of Franklin will never be complete. His known or recognizable periodicals and contributions to periodicals, not in the two great collections of his writings [no doubt Mr. Ford refers to Sparks and Bigelow], would still only be a portion, though a large one, of what he wrote."

Now if so industrious a collector as Mr. Ford thus writes of Franklin's "Bagatelles," it must be that he thought research as to their number and time of printing was exhausted. Yet the American Philosophical Society, founded by Franklin and his associates of the Junto, is to-day in the possession of the largest collection of his papers, and we are naturally interested in trying to answer these questions: When and where did Franklin write his "Bagatelles"? How many copies of each did he print, and what has become of them? It is customary to evade answering such inquiries by saying that Franklin was careless as to his papers, yet the large collection, over seventy great folio volumes, of Franklin Papers in the Library of the Philosophical Society, shows that he at least knew the value of the letters addressed to him, and in this collection they are preserved. Then, too, it is customary to charge William Temple Franklin with indifference to his grandfather's memory and fame, yet Mr. Stevens rescued from oblivion and destruction a great mass of papers, now the property of the United States, and carefully preserved in the Department of State.

Prof. McMaster, in the fifth volume of his history, pp. 294–297,

gives a graphic account of the bitter feud over William Temple Franklin, and his tardy publication of the works of his illustrious grandfather: "Shortly after Franklin's papers, under his will and after his death in 1790, came into the possession of William Temple Franklin, the latter announced the publication, called for those that were scattered in other hands, and yet allowed twenty-seven years to pass before he fulfilled his promise. Meanwhile bookmakers, reviewers and newspaper critics, weary at the delay, abused him roundly. In those days if anything went wrong in our country, and the reason was not easy to find, it was customary to ascribe the evil to the action of Great Britain. Why the promised edition of Franklin's writings was not forthcoming, though a decade and more had passed since his death, was unaccountable. It must therefore be due to the malignity of Great Britain, to whom Temple Franklin was now openly accused of having sold himself. The charge was first made by the *National Intelligencer*, a Jeffersonian newspaper published in Washington. The public, said the editor, is tired with waiting for the appearance of Dr. Franklin's works. Something is wrong. An ugly rumor is afloat that the great man's papers will never be published. It is time for his descendants to explain. No explanation was made, whereupon the *National Intelligencer* returned to the charge in 1804. Silence, said the editor, had given the charge increased weight. More than eight years ago assurances were given repeatedly that an edition was to appear at the same time in Europe and America. Why has it not appeared? Some say because Mr. Temple Franklin sold his copyright to a London bookseller, who in turn sold it for a much greater sum to the British Government, in order that the papers might be suppressed. This plain statement seems to have had some effect, for the next year William Duane, editor of the *Aurora*, and husband of the widow of Benjamin Franklin Bache, advertised for subscriptions to a three-volume edition of Franklin's works; but even this dragged on for thirteen years, when, instead of three, six volumes had been issued. The first volume appeared in 1808; the last in 1818. The charge of suppressing once started in this country crossed the Atlantic, and in 1806 appeared in the preface to a three-volume edition of Franklin's writings, edited by his old friend, Benjamin Vaughan, at London, the preface dated April 7, 1806. When, says Vaughan, Temple Franklin thought his manuscript ready for the press, he offered it to the London printers, but his

In that collection there are the original manuscripts of two of the "Bagatelles;" there are others in the American Philosophical Society, reproduced in the earlier pages of this paper. With these exceptions, nothing is known of the fate of the original manuscripts of the others of this interesting series of Franklin's papers.

Sparks prints in the second volume of his works of Franklin seventeen of them, the first of them, *The Levee*, with a note by William Temple Franklin: "This was one of several articles written by Franklin for the amusement of his friends, and found in a portfolio endorsed 'Bagatelles.'"

Bigelow prints, in Vol. 6 of his works of Franklin, *The Ephemera, an Emblem of Human Life*, addressed to Mme. Brillon; *The Whistle*, addressed to Mme. Brillon, and others of these "Bagatelles." There is an original draft of part of the second, in Franklin's handwriting, in Vol. 50 of the Franklin Papers in the Philosophical Society's collection.

Ford, in his Bibliography, says: "Of the 'Bagatelles' printed by Franklin on the press which he set up in his house at Passy, only one, so far as I can learn, No. 345 [the fictitious supplement to the *Boston Chronicle*], has been preserved, and so my authority for giving such editions of *The Ephemera, The Whistle, the Dialogue between Franklin and the Gout*, and *Advice to Those Who Would Remove to America*, is derived from the statement of the editor of *The Way to Wealth*, Paris, 1795."

Mr. Ford's best contribution is his long list of reproductions of these "Bagatelles," *e. g.*, *The Whistle*, in Burlington in 1792, at Paris in 1795, Newcastle, 1810 and 1818; Paris, 1831. As to his statement that only one original copy of any of the "Bagatelles" is known, it may be said that the large and little known collection of the Philosophical Society has the printed originals of *La Belle et la Mauvaise Jambe*, Passy, 1779, one of the "Bagatelles," and of the supplement to the *Boston Chronicle*, in two editions, one with, the other without the John Paul Jones letter. This is the famous skit in which there is a pretended proclamation by the British offering rewards for scalps of whites; it is an answer to a similar production issued in England, only with the parts reversed; it had a great vogue, and was reproduced throughout Europe and America, just as was Franklin's pretended letter of the Elector of Hesse-Cassel. Undoubtedly these were both prepared with a view of influ-

encing contemporary European opinion in favor of the American colonies in their struggle for independence, and both were copied in the innumerable newspapers and news-letters issued in Holland and Brussels and throughout Europe.

Parton, in his *Franklin*, says, at p. 235 of Vol. 2: "To promote the loan ordered by Congress, Franklin wrote an ingenious piece, which he caused to be translated into Dutch, French, Spanish and Italian, and sent to the moneyed capitals of Europe;" and again, another "money article he wrote at this time, entitled 'A Catechism Relative to the English National Debt.'" "Another piece of Franklin's fun bears date at this time, 'A Dialogue between Britain, France, Spain, Holland, Saxony and America.'" Parton also says: "It was for Mme. Brillon that he wrote the letter with the story of paying too dear for *The Whistle* and his amusing piece upon *The Ephemera*, which was copied and recopied so often in Paris that it became as well known as though published. *The Petition of the Left Hand, The Handsome and Deformed Leg, Morals of Chess, Dialogue between Franklin and the Gout*, and other witty effusions of this period were written for the amusement of the circle that met twice a week at Mme. Brillon's. These pieces were probably composed in English by Franklin and translated into French by some member of the company." Parton says: "In his house at Passy Franklin had a small printing press and fonts of type, with which he printed copies of the 'Bagatelles.'"

Ford, in his *Many-sided Franklin* (p. 218), says: "In his own home he (Franklin) set up a press and types, all of which he or his servants cast." In Bigelow's Works, Vol. 6, p. 474, there is a letter from Franklin of October 29, 1779, to Fizeaux and Grand, saying "eight boxes of printing characters are sent from London to your care for me," and directing that they be insured for £100, via Rouen. Ford says: "These printing materials Franklin brought with him to America, on his return from France, and used them to establish his grandson, B. F. Bache, in business as a printer." Bigelow, in his *Life of Franklin*, Vol. 3, pp. 375*b* and *c*, prints Franklin's certificate, dated Philadelphia, February 25, 1786, that "the printing types with which he furnished Mr. Francis Child, contained in fifteen boxes, marked B. F., Nos. 9, 10, 23, 24, 25, 26, 27, 28, 32, 33, 38, 53, 54, 59, 60, were made in my house at Passy, by my servants, for my use, and were never

the property of any European letter founder, manufacturer or merchant whatsoever." Bigelow also gives at the same place a translation of a letter from Mme. Helvetius to Franklin, dated July, 1787, and the original from the Franklin Papers in the American Philosophical Society. In the collection in Washington, the remains of that of William Temple Franklin, rescued by Stevens from oblivion, are the two manuscript "Bagatelles" on *Perfumes* and on *Marriage;* these were reprinted by Stevens in handsome style in London in 1881, copies on vellum were also produced. Henry Stevens fondly imagined that his copy of the supplement to the *Boston Chronicle* was unique, but the collection of the Philosophical Society shows that both Stevens and Ford were ignorant of the extent of the Franklin papers preserved here, now in process of careful examination, and likely to add to the material for a better knowledge of Franklin's literary activity.

Even Mr. Ford's exhaustive Bibliography, as the author admits, does not give us all that Franklin wrote and printed, nor all of the numerous republications. Franklin himself, it is said, corrected the proofs of Vaughan's edition of his works, printed in London in 1779, but after that date he wrote and printed many of his cleverest skits. In a book published in Paris in 1818, *Correspondence Secrète*, Franklin, in a letter to Mrs. Thompson, dated Paris, February 8, 1777, speaks of "Ces Bagatelles," so it must have been even then a favorite word with him. In the same volume there is a note to the "Bagatelle," *Visite aux Champs Élysée*, addressed to Mme. Helvetius: "Cette lettre a été écrite en français par Franklin."

The extent of Franklin's knowledge of how to speak and write French accurately has frequently been discussed, and he certainly availed himself of a good deal of license in his pretended Letter from the Elector of Hesse-Cassel, although of course the joke was a good deal heightened by pretending that that German Prince was no better master of the French language than Franklin. It is of this skit that Franklin wrote, on May 1, 1777, to John Winthrop (the Professor of Natural History in Harvard): "I send enclosed one of the many satires that have appeared on this occasion"—*i. e.*, the conduct of those Princes of Germany who have sold the blood of their people to Great Britain to be used in opposing the Americans in their effort to achieve their independence. It is a curious coincidence that in this

satire Franklin makes the Count de Schaumburg (his pseudonym for the hereditary Prince of Hesse) write to Baron Hohendorff, commanding the Hessian troops in America, and that among the letters addressed to Franklin, and preserved in the large collection of his papers in the Philosophical Society, is one dated February 25, 1778 (No. 130, Vol. 8), from C. M. Hillegas, at York Town, introducing Baron de Holtzendorff, and later one from Baron Holtzendorff, dated Paris, September 11, 1779, asking for an interview.

It is a good answer to the charge that Franklin was careless as to his papers, that he preserved apparently everything addressed to him and everybody wrote to him. This collection is now being carefully indexed, so that hereafter there may be still more thorough knowledge of Franklin's busy life.

Stevens, in his pamphlet on his collection sold to the United States Government, says that Franklin's essays were printed in a pirated edition by Buisson in Paris in 1791, and in London in 1793 by Parsons in one volume, and by Robinson in two, both from the French of Buisson, which was itself a translation from Franklin's originals. It is hard to find out what became of these. Were they used by Castera in his edition of Franklin's writings, published by Buisson in Paris in 1797, or did they share the fate of the originals used, it is charged, by William Temple Franklin as "printer's copy" for his edition, published in London in 1817, in an 8vo edition in six volumes, and a quarto edition in three volumes, and by Duane in Philadelphia in 1818 in six volumes 8vo? Both Temple Franklin and Duane must have had access to the originals, and yet what survived of the Temple Franklin collection, which passed through Stevens to the library of the State Department at Washington, contains only two manuscript "Bagatelles," although Stevens, in his pamphlet description, says his collection contains original manuscripts by Franklin, his essays, miscellaneous writings, squibs, bagatelles, etc.; but Stevens was mistaken in supposing that his was a unique copy of the pretended supplement to the *Boston Chronicle*, and he ignored or was ignorant of the copies of Franklin's "Bagatelles" in New York and Philadelphia. Still it remains a mystery yet unsolved as to what became of most of the originals, or of the few copies printed on Franklin's Passy press. Even if only enough, ten or a dozen, were all that he printed for his friends there, it seems un-

likely that he would have destroyed the originals, or that his friends would have destroyed the printed copies, even then rare enough to be precious.

The republication throughout Europe and America of his political squibs was clearly part of Franklin's constant and successful effort to enlist allies for America, and to increase the hostility to England in France and Spain, in Holland and Germany, and in England itself. It is a question whether Franklin included in his "Bagatelles" the political squibs which he fired with such telling effect among the enemies of his country, and with such success in making friends for it. His experience in filling his newspaper and his almanac with clever jeux d'esprit stood him in good stead in Paris, and he reproduced many of them for the amusement of his French friends, who were ready to accept with delight everything that he printed. It would be of interest to discover somewhere a complete list of his "Bagatelles," and to learn in what succession they were written, and how many were printed, to whom they were given, and what has become of them.

The collection of the Franklin Papers in the Philosophical Society contains original "Bagatelles" in Franklin's handwriting, and translations apparently by M. Brillon, "un savant," and by Mme. Brillon, who calls herself "une femme qui n'est point savante." Then, too, it has innumerable letters from Mme. Brillon and her family, with many discussions over Franklin's French and over the translations. One letter declines a proposal by William Temple Franklin for the hand of one of the Brillon daughters, and next to it is the notice of the wedding of Mdlle. Brillon. The correspondence of Franklin and Mme. Brillon is characteristic alike of the writers and of the time in which they lived, and it shows how readily Franklin took his part in the life of Paris of his day. Sparks was too serious to care for these pleasing trifles, and too solemn to print even Washington's familiar phrases or Franklin's light and incautious wit; later historical students have censured Sparks for his endeavor to give to the great men of our history a sort of classical pose, as if they were not mortals with average human failings. He had access apparently to much material that he did not print, as being below his high standard of historical dignity. Nowadays we are only too anxious to get at these great men as they were in everyday life, and to rescue from oblivion all they said and wrote, even Franklin's most risky and unrestrained

license with his ready pen. Bigelow has labored hard to restore Franklin's Autobiography as he wrote it, and not as it was printed with corrections from the hand of Temple Franklin and his co-laborers in editing it. Ford and McMaster and Fisher have endeavored to set before their readers the real Franklin, and Parton dwells affectionately on his life in Paris, where he was the centre of a group of admirers, who carried their flattery to a point that shocked his sober-minded colleagues.

It was characteristic of Franklin that he used his position as a man of science and as a man of letters to advance the interests of his country, to forward its cause, and to cement that alliance which secured for the American colonies the vast resources of the French Government, its army, its navy, and its representatives, Lafayette, Rochambeau and the many other gallant soldiers and sailors, who both by their deeds and by their writings helped to make the young republic known abroad, and to bring here many of those who have contributed its best elements to our population. The friends of Franklin in Paris included Voltaire, Hume, Turgot, Marmontel, d'Holbach, Le Roy, the Abbés Morellet and La Roche; all these are mentioned in the letter to the last printed in Vol. 5, p. 283, of the edition of his works, London, 1819. Then Mme. Helvetius, Mme. Brillon and a number of other clever women belonged to the little knot of his intimate friends for whom these "Bagatelles" were written. In the voluminous collection of Franklin's Papers in the Library of the American Philosophical Society are evidences of the care with which he preserved his papers. These show the pains he took to have his "Bagatelles" translated into French good enough to withstand the criticism of his French friends, while he no doubt sought in this way to improve his own knowledge and mastery of the French language, so that he could both write and speak it. Thus in Vol. 45, No. 149½, is a draft of a letter, on the right in English, on the left in French, but the latter corrected in red ink in another hand than that of the first draft of the translation; it is dated Passy, November 16, 1779, and is *The Story of the Whistle*, which has passed into the popular use of all reading people of all countries. Under date of April 8, 1784 (Vol. 45, No. 181) is a letter to Mme. Brillon, enclosing copies of "Bagatelles," and his correspondence with her is largely preserved in one of these seventy bulky volumes. Another "Bagatelle," *The Ephemera*, in Vol. 50, No. 39*a*, is in two manuscript versions in French, perhaps by M.

and Mme. Brillon; these were apparently carefully studied by Franklin, who noted the variances and chose carefully the version printed at his own press, and afterwards by his grandson, Temple Franklin, in what may be called the authoritative edition of his works. Some of them were printed in Vaughan's London edition of his writings, of which he is said to have corrected the proofs. Some of them were printed in the editions of his writings issued in Paris soon after his death. All of them (with the exception of the two still preserved in manuscript in Washington, and printed by Stevens in London and reprinted in Paris) are in Sparks and Bigelow's editions, and a long list of reproductions fills a good many entries in Ford's Franklin Bibliography.

In his *True Benjamin Franklin*, p. 155, Mr. Fisher says: "He has himself told us of the source of one of his best short essays, *The Ephemera*, a beautiful little allegory, which he wrote to please Mme. Brillon in Paris. In a letter to William Carmichael, of June 17, 1780 (Bigelow's *Life of Franklin*, Vol. 2, p. 509), he describes the circumstances under which it was written, and says that "the thought was partly taken from a little piece of some unknown writer, which I met with fifty years since in a newspaper." And at p. 327 Mr. Fisher says: "For Mme. Brillon Franklin wrote some of his most famous essays, *The Morals of Chess*, *The Dialogue between Franklin and the Gout*, *The Story of the Whistle*, *The Handsome and Deformed Leg*, and the *Petition of the Left Hand*," and he again refers to the letter to Carmichael, in which Franklin writes: "Enclosed I send you the little piece you desire [*The Ephemera*]. To understand it rightly, you should be acquainted with some few circumstances. The person to whom it was addressed is Madame Brillon, a lady of most respectable character and pleasing conversation, mistress of an amiable family in this neighborhood, with which I spend an evening twice in every week. She has, among other elegant accomplishments, that of an excellent musician, and with her daughter, who sings prettily, and some friends who play, she kindly entertains me and my grandson with little concerts, a cup of tea, and a game of chess. I call this *my opera*; for I rarely go to the opera in Paris. The Moulin Joli is a little island in the Seine, about two leagues hence, part of the country seat of another friend, where we visit every summer, and spend a day in the pleasing society of the ingenious, learned and very polite persons who inhabit it. At the time when the letter was written, all con-

versations at Paris were filled with disputes about the music of Gluck and Picini, a German and an Italian musician, who divided the town into violent parties. A friend of this lady having obtained a copy of it, under a promise not to give another, did not observe that promise; so that many have been taken, and it is become as public as such a thing can well be that is not printed; but I could not dream of its being heard of at Madrid [where Carmichael was Secretary to the American Legation while Mr. Jay was Minister there]. The thought was partly taken from a little piece of some unknown writer, which I met with fifty years since in a newspaper, and which the sight of *The Ephemera* brought to my recollection."

It is eminently proper that the Franklin Papers should be cared for in the Society of which he was the founder and the first President, and with which his name is so indissolubly connected; it is the duty of this Society to see that these papers be put into a good condition, that they may be freely used by students. Unluckily, when this gift was made to the Society there were few men who knew how to make the best use of it. The late Mr. Trego, then the Librarian, had this vast and heterogeneous mass of original papers, including an infinite number of letters addressed to Franklin and many important papers belonging to the various phases of his long and active and varied career in science, in local and colonial and national and international affairs, roughly mounted and still more roughly bound in an indefinite and vague sort of chronological order. In the course of years access was so carelessly given that some autograph hunters have ruthlessly cut out signatures and thus defaced valuable original papers. A rough index precedes some of the volumes, but many of them are largely made up of papers that are only described by general headings. Later volumes of papers, long unbound and found merely tied up in the original packages—no doubt by Temple Franklin or Bache or Duane, for some of the frequent removals from Passy to Philadelphia and then from pillar to post, until they finally reached a safe haven of rest in the Library of the Philosophical Society—have been carefully mounted, well ordered and arranged, and bound in a creditable way, so that these are now perfectly accessible and safe for use, under the watchful eye of the present custodian, the Librarian, to whose intelligent care this Society is indebted for the order and preservation of many of the important original papers in our archives. Under his direction,

too, the work of indexing these papers is being carried on, and a printed Calendar will, it is hoped, soon make them available for students and others engaged in historical research; and his assistants, who are expert copyists, will supply perfect transcripts. To their careful handiwork is due the transcription of those of Franklin's "Bagatelles," found in manuscript in his papers, here reproduced as part of this paper. They show the infinite care and the exhaustless industry with which he prepared these papers, as though he anticipated the respect with which to-day everything relating to him is regarded in the country that is so proud of his fame.

The original manuscripts show that Franklin's "Bagatelles" were no inconsidered trifles, but were carefully written in his own good English, were carefully translated into French by competent hands, and that in more than one version, then carefully compared, and the one chosen for printing carefully revised; and this studious and loving care, although hidden from the general eye, no doubt gave them that admirable form which has made them so popular, and has commended them to readers of all nationalities from Franklin's day to our own. It is certainly interesting through these old papers to see just how he worked and wrote and gave a final form to these his lightest writings. These papers show that Franklin, in his letter of April 8, 1784, written at Passy to Mme. Brillon, says that *The Advice to Those Who Wish to go to America, Remarks on the Politeness of Savages, The Handsome and Deformed Leg* and *The Morals of Chess*, with those he then sent—no doubt *The Ephemera, The Story of the Whistle, The Dialogue between Franklin and the Gout*—make a complete collection of all his "Bagatelles" printed at Passy. If that be so, what authority had Temple Franklin for the seventeen papers printed by him under the title of "Bagatelles," other than his statement that they were "found in a portfolio, endorsed 'Bagatelles?'" Yet who was better able to speak with authority than Temple Franklin, grandson, literary fellow-worker and testamentary owner?

MAGELLANIC PREMIUM.

FOUNDED IN 1786, BY
JOHN HYACINTH DE MAGELLAN,
OF LONDON.

1901.

THE AMERICAN PHILOSOPHICAL SOCIETY,

Held at Philadelphia, for Promoting Useful Knowledge

ANNOUNCES THAT IN

DECEMBER, 1901,

IT WILL AWARD THE

MAGELLANIC GOLD MEDAL

to the author of the best discovery, or most useful invention, relating to Navigation, Astronomy, or Natural Philosophy (mere natural history only excepted) under the following conditions:

1. The candidate shall, on or before November 1, 1901 deliver, free of postage or other charges, his discovery, invention or improvement, addressed to the President of the American Philosophical Society, No. 104 South Fifth Street, Philadelphia, U. S. A., and shall distinguish his performance by some motto, device, or other signature. With his discovery, invention, or improvement, he shall also send a sealed letter containing the same motto, device, or signature, and subscribed with the real name and place of residence of the author.

2. Persons of any nation, sect or denomination whatever, shall be admitted as candidates for this premium.

3. No discovery, invention or improvement shall be entitled to this premium, which hath been already published, or for which the author hath been publicly rewarded elsewhere.

4. The candidate shall communicate his discovery, invention or improvement, either in the English, French, German, or Latin language.

5. A full account of the crowned subject shall be published by the Society, as soon as may be after the adjudication, either in a separate publication, or in the next succeeding volume of their Transactions, or in both.

6. The premium shall consist of an oval plate of solid standard gold of the value of ten guineas, suitably inscribed, with the seal of the Society annexed to the medal by a ribbon.

All correspondence in relation hereto should be addressed

TO THE SECRETARIES OF THE

AMERICAN PHILOSOPHICAL SOCIETY,

NO. 104 SOUTH FIFTH STREET,

PHILADELPHIA, U. S. A.

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To the Secretaries of the

AMERICAN PHILOSOPHICAL SOCIETY,

104 South Fifth Street,

Philadelphia, U. S. A.

Members will please communicate to the Secretaries any inaccuracy in name or address as given on the wrapper of this number.

It is requested that the receipt of this number of the Proceedings be acknowledged to the Secretaries.

Members who have not as yet sent their photographs to the Society will confer a favor by so doing; cabinet size preferred.

PROCEEDINGS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY

HELD AT PHILADELPHIA FOR PROMOTING USEFUL KNOWLEDGE.

VOL. XL. DECEMBER, 1901. No. 167.

Special Meeting, September 26, 1901.

Vice-President BARKER in the Chair.

Present, 36 members.

A special meeting was held at noon to take action upon the death of the Hon. Frederick Fraley, LL.D., President of the Society.

The Secretaries announced the death, on Monday, September 23, 1901, in the ninety-eighth year of his age, of the Hon. Frederick Fraley, the President of the Society.

Vice-President Barker made some remarks on the loss sustained by the Society in the death of its President.

Prof. Albert H. Smyth offered the following minute and resolution:

In the death of Frederick Fraley, on the 23d of September, 1901, the American Philosophical Society has lost its President, who had held his office since January 2, 1880.

Under the instant sense of bereavement it is not easy to record our appreciation of his superb stability of character and of his life-long devotion to duty.

He was elected to this Society July 15, 1842, and for fifty-nine years took a deep and fervid interest in its welfare and progress. He was faithful in every duty and adequate in every trial. He presided over the deliberations of the Society with wisdom and dignity and judgment and grace. His tact was unerring and his

patience unfailing. Simplicity and truthfulness were natural to him. All his impulses were generous and good.

He had an intuitive sense of the obligation of noble living, and he passed through the vicissitudes of human experience calmly and bravely, without fever and without fear.

In philosophy he had broad vision and ample equipment, and he sympathized quickly and cordially with the march of thought. In politics he illustrated the scope and fidelity of republican citizenship.

In his social relations he exercised a peculiar personal influence. He was distinguished by the repose of his manners, his cheerful temperament, and his eager, joyous, sanguine vitality. He surrounded himself with cheerfulness. His friendship was never idly given, but those who knew him well loved him dearly, for in sunshine or in storm he was alike steadfast and true.

He has gone from us in extreme old age—the labor of his life well done—in the full possession to the last of his lucid perception and dauntless cheer, and he leaves us the precious memory of a tranquil and beautiful character and the priceless possession of a high and rare example of noble living.

Resolved, That the Chair appoint a member of the Society to prepare an eulogium of Mr. Frederick Fraley.

The minute and resolution were seconded with eulogistic remarks by Messrs. Philip C. Garrett, Joel Cook, Hampton L. Carson, William V. McKean and Harold Goodwin, and were unanimously adopted.

The meeting was then adjourned by the presiding officer.

Stated Meeting, October 4, 1901.

Vice-President SELLERS in the Chair.

Present, 10 members.

Letters were read as follows:

From Prof. Schiaparelli, of Milan; Thomas Willing Balch, Amos P. Brown, Dana C. Munro and Mazÿck Ravenel, of

Philadelphia, accepting membership, and from Hon. J. B. McPherson, of this city, declining membership.

From the Corporation of Yale University, inviting the Society to be represented at the celebration of the 200th anniversary of the founding of Yale College, and on motion Dr. G. F. Barker was chosen to represent the Society.

From the Naturhistorische Gesellschaft, in Nürnberg, inviting the Society to be represented at the 100th anniversary of the founding of the Society.

From the municipality of Verona, Italy, acknowledging the receipt of the portraits of the Scaligers, recently sent by the Society.

A letter from a Committee of the Anthropological Section of the American Association for the Advancement of Science, asking the Society to appoint a representative to the General Committee of the International Congress of Americanists, and on motion the presiding officer was authorized to appoint such representative.

A letter from the Academia Degli Agliati in Roverto, inviting the Society to be represented at a commemorative conference of the Academy, to be held on the 2d of June past.

A letter from the late President, Frederick Fraley, dated May 29, appointing as a Committee to arrange for a general meeting of the Society—Prof. George F. Barker, Prof. E. G. Conklin, Prof. C. E. Doolittle, Prof. William B. Scott and Prof. W. P. Wilson.

A list of donations to the Library was laid upon the table, and the thanks of the Society ordered therefor.

The following deaths of members were announced:

Albin Weisbach, February 26, 1901, Freiberg, Germany.

Thomas C. Clarke, June 15, 1901, New York.

Benjamin Chew Tilghman, July 3, 1901, Philadelphia.

Joseph Le Conte, July 6, 1901, Berkeley, Cal.

Herbert B. Adams, July 30, 1901, Baltimore, Md.

Charles A. Schott, July 31, 1901, Washington, D. C.

Jacob D. Cox, August 4, 1901, Cincinnati, Ohio.

Adolph Nordenskjold, August 12, 1901, Stockholm, Sweden.

William Ludlow, U.S.A., August 30, 1901, Washington.
Waldron Shapleigh, August 30, 1901, Philadelphia.
Pascual de Guyangos, October 4, 1897, London, Eng.
Papers were read as follows:
"On Friedrich Nietzsche," by A. Radcliffe Grote.
"On the Gundungurra Language," by R. H. Mathews.
"Notes on Pure Circulating Decimals," by C. M. Fennell.
The Society was adjourned by the presiding officer.

THE GUNDUNGURRA LANGUAGE.

BY R. H, MATHEWS, L.S.

(*Read October 4, 1901.*)

The Dhar'rook and Gun'dungur'ra tribes respectively occupied the country from the mouth of the Hawkesbury river to Mount Victoria, and thence southerly to Berrima and Goulburn, New South Wales. On the south and southeast they were joined by the Thurrawal, whose language has the same structure, although differing in vocabulary.

Besides the verbs and pronouns, many of the nouns, adjectives, prepositions and adverbs are subject to inflection for number and person. Similar inflections have, to some extent, been observed in certain islands of the Pacific Ocean, but have not hitherto been reported in Australia. I have also discovered two forms of the dual and plural of the first personal pronoun, a specialty which has likewise been found in Polynesian and North American dialects. Traces of a double dual were noticed by Mr. Threlkeld at Lake Macquarie, New South Wales, and traces of a double plural by Mr. Tuckfield in the Geelong tribe; but the prevalence of both forms of the dual and plural in different parts of speech in any Australian language has, up to the present, escaped observation.

ORTHOGRAPHY.

Nineteen letters of the English alphabet are sounded, comprising fourteen consonants—b, d, g, h, j, k, l, m, n, p, r, t, w, y—and five vowels—a, e, i, o, u. Every word is spelled phonetically, the letters

having the same value as in English, with the following qualifications:

Unmarked vowels have the usual short sound.

Vowels having the long sound are distinguished by the following marks:

ā as in fate	ī as in pie	oo as in moon
â as in father	ô as in pole	ee as in feel
	ou as in loud	

It is frequently difficult to distinguish between the short or unmarked sound of a and that of u. A thick or dull sound of i is occasionally met with, which closely approaches the short sound of u or a.

G is hard in every instance.

R has a rough trilled sound, as in hurrah!

Ng at the beginning of a word, as ngee = yes, has a peculiar sound, which can be got very closely by putting oo before it, as oong-ee', and articulating it quickly as one syllable. At the end of a word or syllable it has substantially the sound of ng in our word sing.

The sound of the Spanish ñ is frequent, both at the beginning or end of a syllable.

Y, followed by a vowel, is attached to several consonants, as in dya, dyee, tyoo, etc., and is pronounced therewith in one syllable, the initial sound of the d or other consonant being retained. Y at the beginning of a word or syllable has its usual consonant value.

Dh is pronounced nearly as th in "that" with a slight sound of the d preceding it.

Nh has nearly the sound of th in "that" with an initial sound of the n.

The final h is guttural, resembling ch in the German word "joch."

T is interchangeable with d, p with b, and g with k in most words where these letters are employed.

A sound resembling j is frequently given by the natives, which can be represented by dy or ty; thus, dya or tya has very nearly the same sound as ja.

In all cases where there is a double consonant, each letter is distinctly enunciated.

W always commences a syllable or word and has its ordinary consonant sound in all cases.

At the end of a syllable or word, ty is sounded as one letter; thus, in beety-bal-lee-mañ, it is disappearing, the syllable beety can be obtained by commencing to say "beet-ye," and stopping short without articulating the final e, but including the sound of the y in conjunction with the t—the two letters being pronounced together as one.

Articles.

The equivalents of the English articles, "a" and "the," do not occur in this language.

Nouns.

Number.—Nouns have the singular, dual and plural:

(1) *Singular*	A man	Murriñ
Dual	A pair of men	Murriñboolallee
Plural	Several men	Murriñdyargang
(2) *Singular*	A kangaroo	Booroo
Dual	A pair of kangaroos	Booroolallee
Plural	Several kangaroos	Boorooyargang

It will be observed that the dual and plural suffixes vary slightly in form, according to the termination of the noun.

Gender.—Mur'riñ, a man; bul'lan, a woman; boobal, a boy; mullunga, a girl; goodha, a child of either sex; warrambal, a young man. Another name for a man is boual; a married man is kunbeelang; a married woman is boualillang. Generally the males of animals are distinguished by the addition of goomban, and the females by dhoorook. The males of certain animals have a name which distinguishes them without stating the sex; thus, the male of wallee, the opossum, is known as jerrawul, while the female is wallee dhoorook. Goola, the native bear, has burrandang for the male and goola dhoorook for the female. A few animals have a distinctive word for the female as well as for the male; thus, the female of the wallaroo is bâwa, and the male goondarwâ. Others again have the suffix koual for the male, and ñoual for the female. The words for "male" and "female" are inflected for number like other adjectives.

Case.—There are two forms of the nominative, the first naming the subject at rest; as, Boual ngabooromañ, the man sleeps. The

second shows that the subject is doing some act; thus, mirreegangga wallee burrârañ, the dog an opossum bit. Mirreegang is a dog in the first nominative.

The possessive case takes a suffix both to the possessor and that which is possessed:

Murringoo warrangangoong, a man's boomerang.
Mirreegangoo goodhâwoong, a dog's puppy.
Bullangoo goodhâyarroong, a woman's children.
Booroongoo dhoombirgoong, a kangaroo's tail.

Any object over which one can exercise ownership can be conjugated by possessive suffixes for number and person:

Singular.	First Person . . . My boomerang		Warrangandya
	Second Person . . Thy boomerang		Warranganyee
	Third Person . . His boomerang		Warrangangoong
Dual . .	First Person . .	Our boomerang, incl.	Warrangangulla
		Our boomerang, excl.	Warrangangullang
	Second Person . . Your boomerang		Warranganboola
	Third Person . . Their boomerang		Warranganboolangoo
Plural .	First Person . .	Our boomerang, incl.	Warranganyinnang
		Our boomerang, excl.	Warranganyillung
	Second Person . . Your boomerang		Warranganyoorung
	Third Person . . Their boomerang		Warrangandyunnung

The accusative does not differ from the nominative. There are a few forms of nouns for the dative and oblative, but these cases are frequently shown by modifications of the verb; as, I carried to him, he carried from me. They are also indicated by the pronouns; as, with me, to me.

Pronouns.

Pronouns are inflected for number, person and case. There are two forms of the dual and plural in the first person. The following table shows the nominative and possessive cases:

Singular.	I	Goolangga	Mine	Goolanggooya
	Thou	Goolanjee	Thine	Goolanyingoo
	He	Dhannooladhoo	His	Dhannoogoolangoo
Dual . .	We, incl.	Goolanga	Ours, incl.	Goolangalja
	We, excl.	Goolangaloong	Ours, excl.	Goolangaloong
	Ye	Goolamboo	Yours	Goolambooloong
	They	Dhannooboola	Theirs	Dhannooboolangoo

Plural.	We, incl.	Goolanyan	Ours, incl.	Goolanyannung
	We, excl.	Goolanyilla	Ours, excl.	Goolanyillungoon
	Ye	Goolambanoo	Yours	Goolanthooroong
	They	Ḍhannoojimmalang	Theirs	Goolangandyoolang

These possessives admit of variations to include two or several articles and in other ways. There are also forms of the pronouns signifying, with me, with thee, and so on as follows:

Singular.	First Person.	With me	Goolangngooreea
	Second Person . . .	With thee	Goolangooroonyee
	Third Person	With him	Goolangooroong
Dual. .	First Person . . .	With us, incl.	Goolangooroongulla
		With us, excl.	Goolangooroongullung
	Second Person . . .	With ye	Goolangoorooloong
	Third Person	With them	Goolangooroolangoo
Plural. .	First Person . . .	With us, incl.	Goolangoorooñunnung
		With us, excl.	Goolangoorooñullungoo
	Second Person . . .	With ye	Goolangoorooñooroong
	Third Person	With them	Goolangooroodyunnung

There are other modifications of the pronouns to meet different forms of expression. The demonstratives and interrogatives are inflected for number and person like the rest.

ADJECTIVES.

Adjectives take the same dual and plural numbers as the nouns with which they are used:

(1) Barrĭ buggarabang	A wallaby, large
Barrĭwoolallee buggarabangoolallee	A couple of wallabies, both large
Barrĭdyargang buggarabangargang	Several wallabies, all large
(2) Bullan yeddung	A woman pretty
Bullanboollee yeddungboolallee	A couple of pretty women
Bullandhar yeddungdyargang	Several pretty women

Comparison is effected by saying, This is heavy—that is heavy; this is smooth—that is not; this is sharp—that is very sharp.

When used predicatively, as yooroang or yoorwang, he is strong, an adjective can be conjugated through all the tenses and moods of an intransitive verb:

Present Tense.

Singular.	First Person . .	I am strong	Yooroangga or Yoorwangga
	Second Person	Thou art strong	Yooroandyee
	Third Person . .	He is strong	Yooroang
Dual. . .	First Person . .	We are strong, incl.	Yooroanga
		We are strong, excl.	Yooroangaloong
	Second Person	Ye are strong	Yooroangboo
	Third Person . .	They are strong	Yooroangboola
Plural. .	First Person . .	We are strong, incl.	Yooroanyun
		We are strong, excl.	Yooroanyulla
	Second Person	Ye are strong	Yooroanthoo
	Third Person . .	They are strong	Yooroanjimmalang

The past and future tenses are not given, owing to want of space.

VERBS.

Verbs have the singular, dual and plural numbers, the usual persons and tenses, and three principal moods, viz., indicative, imperative and conditional. The verb-stem and a contraction of the pronoun are incorporated, and the word thus formed is used in the conjugation.

INDICATIVE MOOD.

Present Tense.

Singular.	First Person . .	I throw (throw I)	Yerreemangga
	Second Person	Thou throwest	Yerreemandyee
	Third Person . .	He throws	Yerreemañ
Dual . .	First Person . .	We throw, incl.	Yerreemang'a
		We throw, excl.	Yerreemangaloong
	Second Person	Ye throw	Yerreemanboo
	Third Person . .	They throw	Yerreemanboola
Plural .	First Person . .	We throw, incl.	Yerreemanyan
		We throw, excl.	Yerreemanyalla
	Second Person	Ye throw	Yerreemanthoo
	Third Person . .	They throw	Yerreemandyoolung

Past Tense.

Singular.	First Person . .	I threw (threw I)	Yerreering'ga
	Second Person	Thou threwest	Yerreerindyee
	Third Person . .	He threw	Yerreering

Dual . .	First Person . .	We threw, incl.	Yerreering'a
		We threw, excl.	Yerreeringaloong
	Second Person	Ye threw	Yerreeringboo
	Third Person . .	They threw	Yerreeringboola
Plural .	First Person . .	We threw, incl.	Yerreeooranyan
		We threw, excl.	Yerreeooranyulla
	Second Person	Ye threw	Yerreeooranthoo
	Third Person . .	They threw	Yerreeooradyoolung

Future Tense.

Singular.	First Person . .	I will throw	Yerreeningga
	Second Person	Thou wilt throw	Yerrenindyee
	Third Person . .	He will throw	Yerreenifi
Dual . .	First Person . .	We will throw, incl.	Yerreening'a
		We will throw, excl.	Yerreeningaloong
	Second Person	Ye will throw	Yerreenimboo
	Third Person . .	They will throw	Yerreenimboola
Plural .	First Person . .	We will throw, incl.	Yerreeninyan
		We will throw, excl.	Yerreeninyulla
	Second Person	Ye will throw	Yerreemunanthoo
	Third Person . .	They will throw	Yerreemunadyoolung

IMPERATIVE MOOD.

Singular . .	Second Person	Throw thou	Yer'-ree
Dual	Second Person	Throw ye	Yer'-ree-ou'
Plural . . .	Second Person	Throw ye	Yer'-ree-a-nhoor'

CONDITIONAL MOOD.

Perhaps I will throw	Yerreeningga	booramboonda

If a negative meaning be required, it is effected by means of an infix, mooga, between the verb-stem and the abbreviated pronoun. One example in the first person singular in each tense will exhibit the negative form of the verb:

I am not throwing	Yerreemoogamangga
I did not throw	Yerreemoogaringga
I will not throw	Yerreemooganingga

This negative infix can be applied in the same manner to all the persons of the three tenses.

There are numerous modifications of the verbal suffixes to convey variations of meaning; as, "I threw at him," "He threw at

me," etc., which can be conjugated for number and person. Case can also be indicated in this way, as already stated in dealing with the nouns.

Verbs have no passive voice. If a native desires to state that a fish was swallowed by a pelican, he would say, "A pelican swallowed a fish."

Prepositions.

Some prepositions can be used separately, as dhooreegoong, between; warroo, around; willinga, behind, and several others, thus: Dhooreegoong ngullawoolee, between trees two or between two trees; gunbee warroo, the fire around or around the fire.

A prepositional meaning is often obtained by a verb; thus, instead of having a word for "up" or "down," a native will say, Boomaningga, up I will go; woorâramuningga, down I will go. Many of the prepositions admit of conjugation for number and person, as in the following example:

Singular.	First Person	Behind me	Willingia
	Second Person	Behind thee	Willinganyee
	Third Person	Behind him	Willingâwoong
Dual.	First Person	Behind us, incl.	Willingangulla
		Behind us, excl.	Willingangullung
	Second Person	Behind ye	Willingangâwooloong
	Third Person	Behind them	Willingangawoolangoo
Plural.	First Person	Behind us, incl.	Willinganyanung
		Behind us, excl.	Willinganyanungoo
	Second Person	Behind ye	Willinganthooroong
	Third Person	Behind them	Willingadyanung

Adverbs.

Space will not permit of a list of adverbs any further than to illustrate how some of them can be conjugated:

Singular.	First Person	Where go I	Ngoondeeneea
	Second Person	Where goest thou	Ngoondeeneeñee
	Third Person	Where goes he	Ngoondeeneeoong
Dual.	First Person	Where go we, incl.	Ngoondeeneenga
		Where go we, excl.	Ngoondeeneengoolung
	Second Person	Where go ye	Ngoondeeneewoo
	Third Person	Where go they	Ngoondeeneewoola

Plural .	First Person . .	Where go we, incl.	Ngoondeeneeñnun
		Where go we, excl.	Ngoondeeneeñulla
	Second Person	Where go ye	Ngoondeeneeñoo
	Third Person .	Where go they	Ngoondeeneeyoolung

Adverbial meanings are sometimes conveyed by means of verbs, as beetyballeemañ, he (or it) goes out of sight. Conjunctions and interjections are few and unimportant.

NOTES ON PURE CIRCULATING DECIMALS.

BY C. A. M. FENNELL, CAMBRIDGE, ENGLAND.

(*Read October 4, 1901.*)

§ 1. The following properties of cyclic periods of decimals are supplementary to those discussed by Prof. Glaisher in the *Proceedings* of the Cambridge Philosophical Society, October 28, 1878, Vol. III, Part v.

§ 2. The following letters, definitions and theorem are taken from p. 185 of Prof. Glaisher's paper. The periods that arise from the series of fractions $\frac{p}{q}, \frac{p}{q}$ being a vulgar fraction in its lowest terms, and p having all values less than q (which is prime to 10), are called the periods of the denominator q, or, more simply, the periods of q. Theorem: the denominator $\varphi(q)$, which includes all the above values of p, has a certain number (n) of periods, each containing the same number (a) of digits, n and a being connected by the relation, $na = \varphi(q)$.

§ 3. (i) The first inquiry relates to the distribution of the several digits, 0, 9, 3, 6, 1, 8, 2, 7, 4, 5, over the n periods of a digits which constitute Prof. Glaisher's $\varphi(q)$. In this particular a difference emerges between 0, 9, 3, 6, and the rest of the digits, the observation of which may prove important to the theory of numbers.

Of course there must always be as many 9s as 0s, 3s as 6s, 1s as 8s, etc., but as verified up to $\frac{1}{101}$ there are the same number, say m, of each of the six digits, 1, 8, 2, 7, 4, 5, m being a positive integer.

E.g., in the single period of $\frac{1}{7}$, viz., .$\dot{1}42857\dot{}$, each of the six

occurs once, and the same with the six periods of $\frac{1}{3}$, viz., $.\dot{1}$, $.\dot{2}$, $.\dot{4}$, $.\dot{5}$, $.\dot{7}$, $.\dot{8}$. In the 5 periods of $\frac{1}{11}$, viz., $.\dot{0}\dot{9}$, $.\dot{1}\dot{8}$, $.\dot{2}\dot{7}$, $.\dot{3}\dot{6}$, $.\dot{4}\dot{5}$, every digit occurs once.

(ii) As might be expected, when an or $\varphi(q)$ is an exact multiple of 10, each of the 10 digits occurs an equal number of times. In other words, if an or $\varphi(q) = 10m$, then each digit occurs m times.

(iii) Prof. Glaisher writes: "Among . . . . results which are illustrated by Mr. Goodwyn's tables . . . . of less importance may be noticed the following: If q be a prime ending with one, viz., $= 10m + 1$, then each of the digits 0, 1, 2 . . . . 9 occurs m times in the $10m$ digits which form the periods of q." This is a partial statement included under the statement in my immediately preceding paragraph and only embracing the cases in which an or $\varphi(q) = q - 1 = 10m$.

It seems a safe inference that my more general statement and its place in the methodical distribution of digits in the periods of q, which is based on the forms both of q and of an or $\varphi(q)$, were not known when Prof. Glaisher wrote as above, and I have reason for believing that they have not been discovered since, or at any rate published since.

(iv) The said methodical distribution of the several digits, so far as traced at present, comprises at least seventeen distinct divisions of cases which fall into five groups, A, B, ... E.

The results have been verified for all values of q from 3 to 401 inclusive, and for sundry higher values, *e.g.*, 419, 423, 487, 507, 603 and 621.

(v)

A 1. If an or $\varphi(q) = 10m$, then for all values of q each of the digits 0, 1, 2, ... 9 occurs m times in the period or periods of q.

B 2. If an or $\varphi(q) = 10m + 2$ and $q =$ either $10\beta + 1$ or $10\beta + 7$, then 0, 9 occur $m + 1$ times each, and the other digits m times each. [But for $q = 357$ ($an = 192$), 0, 9, 3, 6 occur 18 times ($m - 1$) each, and the other digits 20 times ($m + 1$)].

B

3. If an or $\varphi(q) = 10m + 2$ and $q = 10\beta + 3$ or $10\beta + 9$, then 3, 6 occur $m + 1$ times and the other digits m times each.

4. If an or $\varphi(q) = 10m + 4$ and $q = 10\beta + 1$, then 0, 9, 3, 6 occur $m + 1$ times each and the other digits m times each.

5. If an or $\varphi(q) = 10m + 4$ and $q = 10\beta + 3$, then 0, 9, 3, 6 occur $m + 1$ times each, and the other six digits m times each.

C

6. If, however, q is a multiple of 3, then 3, 6 occur $m + 2$ times each, and the other digits m times each.

7. If an or $\varphi(q) = 10m + 4$ and $10\beta + 7$ or $10\beta + 9$, then 0, 9 occur m times each, 3, 6 $m - 1$ times each and the other digits $m + 1$ times each.

8. If an or $\varphi(q) = 10m + 6$ and $q = 10\beta + 1$ or $10\beta + 3$, or $10\beta + 9$, then 0, 9 occur $m + 1$ times each, 3, 6 $m + 2$ times each and the other digits m times each.

9. If an or $\varphi(q) = 10m + 6$ and $q = 10\beta + 7$, then 0, 9, 3, 6 occur m times each, and the other digits $m + 1$ times each.

D

10. But if $q = 10\beta + 7 = 3\delta$ or $(10^\theta + 3)\delta$, then 3, 6 occur $m - 1$ times each, and the other digits $m + 1$ times each.

11. If an or $\varphi(q) = 10m + 6$ and $q = 10\beta + 9 = (10\gamma + 3)^2$, then 0, 9, 3, 6 occur m times each, and the other digits $m + 1$ times each.

D
12. But in other cases either 0, 9 occur $m+1$ times each, 3, 6 $m+2$ times each, and the other digits m times each;
13. or 0, 9 occur $m-1$ times each, and the other digits $m+1$ times each.

E
14. If an or $\varphi(q) = 10m+8$ and $q = 10\beta+1$ or $10\beta+3$, then 0, 9, 3, 6 occur $m+2$ times each, and the other digits m times each.
15. If an or $\varphi(q) = 10m+8$ and $q = 10\beta+7$, then 3, 6 occur m times each, and the other digits $m+1$ times each.
16. If an or $\varphi(q) = 10m+8$ and $q = 10\beta+9$, then 0, 9 occur m times each, and the other digits $m+1$ times each.
17. But if $q = 10\beta+9 = 11\delta+1$ (*e.g.*, 89, 199 or 419), then 3, 6 occur $m-4$ times, and the other digits $m+2$ times each, or some other exceptional distribution is found.

(vi) The total number of values of q up to 401 is 160.

A 1. Includes 18 primes (counting 401) and 22 multiples or powers of primes.

B 2. No primes; 15 cases with $q = 10\beta+1$, only 3 cases with $q = 10\beta+7$, and the exceptional case $q = 357 = 3 \times 7 \times 17$. Beyond 401, $q = 507$ is regular. But the limits of the investigation do not present sufficient data for sound inference as to the cases where $q = 10\beta+7$.

B 3. Includes $q = 243$ and 20 primes with 3 for the unit digit and 2 with 9 for the unit digit, namely $49 = 7^2$ and $289 = 17^2$, the next number being $819 = 7 \times 9 \times 13$.

C 4. One case, $q = 81$.

C 5. One case, $q = 343$.

C 6. One case, $q = 273$.

C 7. Five cases, $q = 147$, and 4 cases, $q = 10\beta+9$.

D 8. Nine cases.
D 9. Twenty-three cases.
D 10. Eight cases, 57, 87, 177, 237, 247, 267, 327, 387.
D 11. Two cases, $q = 3^2$ and $q = 13^2$.
D 12. Three cases, $q = 119$ and $q = 259$, $q = 329$.
D 13. One case, $q = 399$.
E 14. Five cases, $q = 273$, $q = 343$, $q = 133$, $q = 203$, $q = 353$.
E 15. One case, $q = 27$.
E 16. Sixteen cases.
E 17. Two cases, $q = 89$, $q = 199$.

There is then a strong *prima facie* case in favor of a regular classification of the numerical distribution of the digits in various cases of $\varphi(q)$, but not a sufficient number of cases at present investigated for a complete and certain induction, which would moreover demand an explanation of the causes which lead to the observed results. A complete investigation would probably supply eight or ten more divisions of cases, as C 4, C 5, C 6, D 13, E 15, E 17 are probably susceptible of subdivision, and under B 2 the case $q = 357$ may be the lowest case of a distinct division.

The possibility of occasional exceptions must be frankly admitted, at any rate for the present.

EXAMPLES.

(vii) For $q = 3^4 = 81$, $\varphi(q) = 54$, $a = 9$, $n = 6$, the periods are

.$\dot{0}$1$\dot{2}$345$\dot{5}\dot{7}\dot{9}$ containing all the digits except 8.
.$\dot{9}$87654$\dot{3}\dot{2}\dot{0}$ " " " " 1.
.$\dot{0}$24691$\dot{3}\dot{5}\dot{8}$ " " " " 7.
.$\dot{9}$7530864$\dot{1}$ " " " " 2.
.$\dot{0}$49382$\dot{7}$1$\dot{6}$ " " " " 5.
.$\dot{9}$50617$\dot{2}\dot{8}\dot{3}$ " " " " 4.

Therefore obviously 0, 9, 3, 6 occur 6 times each and the other six digits 5 times each.

For $q = 3 \times 11 = 33$, $\varphi(q) = 20$, $a = 2$, $n = 10$, the periods are .$\dot{0}\dot{3}$, .$\dot{0}\dot{6}$, .$\dot{1}\dot{2}$, .$\dot{1}\dot{5}$, .$\dot{2}\dot{4}$, .$\dot{3}\dot{9}$, .$\dot{4}\dot{8}$, .$\dot{5}\dot{7}$, .$\dot{6}\dot{9}$, .$\dot{7}\dot{8}$, in which every digit occurs twice.

For $q = 31$, $\varphi(q) = q - 1 = 30$, $a = 15$, $n = 2$, the periods are .$\dot{0}$32258064516129 and

.967741935483870, in which every digit occurs 3 times, each pair of complements of 9 contributing 3 digits to each period.

§ 4. The phenomena noted and illustrated in the following paragraphs can be doubtless fully classified and explained by specialists in the theory of numbers:

(i) If when q is prime its period is divisible into sections, each of which contains an equal number of digits—the number being greater than 1—the sum of the sections arranged in column amounts to $10^d - 1$ or a multiple of $10^d - 1$, where d is the number of digits in each section, and the sum of the numerators corresponding to the periods which begin with the several sections is q or a multiple of q.

E.g., for the period of 31, $a = 15$ and $n = 2$, and written in column of 5 sections of 3 digits each the period of $\frac{1}{31}$ is

.032
258
064
516
129 = 999;

and in column of 3 sections of 5 digits each is

.03225
80645
16129 = 99999;

while the five enumerators answering to the sections of 3 digits are 1, 8, 2, 16, 4 = 31, and those answering to the sections of 5 digits are 1, 25, 5 = 31.

For the period of 7, which is .142857 (for which figures see § 6), 14 + 28 + 57 = 99; 85 + 71 + 42 = 198; while 142 + 857 = 999. In the latter case the first half and the second half of the period are complementary. This is an instance of the simplest and most obvious case of the sum of sections of a period being $= 10^d - 1$, and this case must occur, whether q be prime or not, whenever a complementary remainder occurs in the division of p by q. This particular case of complementary halves of a period is not brought under a general theorem relating to sections of periods by Prof. Glaisher.

This property of sections of a period containing an equal number of digits each depends upon the property of the corresponding numerators, viz., that their sum is equal to q or a multiple of q;

for it is obvious that the sum of the sections is equal to the sum of the whole periods which begin with the respective sections.

E.g., for the period of $\frac{8}{81}$ .0̇96 774 193 548 387̇

.7̇74	193	548	387	096̇	
.1̇93	548	387	096	774̇	
.5̇48	387	096	774	193̇	
.3̇87	096	774	193	548̇	
1.9̇98	998	998	998	998̇	$=.\dot{9}\times 2$
+	+	+	+		
1	1	1	1		

(ii) If q be the product of primes or powers of primes or be a power of a prime, then the summation of sections in some instances gives results similar to those obtained when q is a prime. For instance, the period of $\frac{1}{91} = \frac{1}{13\times 7} = .\dot{0}10989\dot{}$, where the first half and the second half of the period are complementary and .01 + 09 + 89 = 99. In other instances, however, variations occur, the general nature of which is to be understood from the inspection of a few examples.

For the periods of 21, viz., .0̇47619̇ and .9̇52380̇ ($\frac{8}{21} = .\dot{0}95238\dot{}$), .047 + 619 = 666, 952 + 380 = 1332 = 4 × 333. The two sums together = 2 × 999. But .04 + 76 + 19 = 99; 95 + 23 + 80 = 198 = 2 × 99. As in some cases in which 3 is a factor of q, the sections when added give $\frac{m}{3}(10^d - 1)$, so when 9 is a factor of q they sometimes give $\frac{m}{3}(10^d - 1)$. *E.g.*, for 117, 008 + 547 = 555, but 00 + 85 + 47 = 132 = 4 × 33, .99 + 14 + 52 = 165 = 5 × 33.

		Corresponding numerators.	
For the period of 49: .0̇20408...		1	
.1̇63265...		8	
.3̇06122...		15	
.4̇48979...		22	
.5̇91836...		29	
.7̇34693...		36	
.8̇77551...		43	
3.1̇42854	$=.\dot{1}42857\times 22$	154	$=7\times 22$
+			
3...	$=.142857\dot{}\times 22$		

To generalize, if a period has a number of digits which is a multiple of the number (f) of digits in the period of a factor (r) of q, then sections of kf digits when added give $\frac{m}{r}(10^{kf}-1)$.

For the period of 221 ($=13\times17$), $a=48$, $n=4$ (*i.e.*, two pairs of complementary periods). The period of $\frac{1}{13}$ is $.\dot{0}76923$.

Sections of 6 digits.	Corresponding remainders or numerators.
$.\dot{0}04524\ldots$	1st — $1 = 0\times13+1$
$.\dot{3}86877\ldots$	7th — $196 = 15\times13+1$
$.\dot{3}28054\ldots$	13th — $183 = 14\times13+1$
$.\dot{2}98642\ldots$	19th — $66 = 5\times13+1$
$.\dot{5}33936\ldots$	25th — $118 = 9\times13+1$
$.\dot{6}51583\ldots$	31st — $144 = 11\times13+1$
$.\dot{7}10407\ldots$	37th — $157 = 12\times13+1$
$.\dot{2}39819\ldots$	43d — $53 = 4\times13+1$
$4.\dot{1}53842 = 54\times.\dot{0}76923$	$918 = 54\times17$
$+$	
$4\ldots\quad 54\times.\dot{0}76923$	

Similarly—

the 2d, 8th... 44th numerators are of the form $\pm m\,13+10$
and the 3d, 9th... 45th " " " " $\pm m\,13+100$
and the 4th, 10th...46th " " " " $\pm m\,13+116$
and so on.

The halves of the period of $\frac{1}{221}=\frac{7}{13}\,(10^{24}-1)$, and the quarters $=\frac{77}{13}\,(10^{12}-1)$, while the thirds $=\frac{13}{17}\,(10^{16}-1)$ and the numerators corresponding to the thirds $=12\times13$. The sixths $=2(10^{8}-1)$. The other periods yield analogous results. Note that $m=0$ in the form of the first 6 numerators, and that the minus sign only occurs for some values of q. Analysis of this kind can be applied generally.

The following partial exhibition of the relations to each other and to 7 and 47 of the remainders of the period of $\frac{1}{7\times47}=\frac{1}{329}$ may perhaps prove suggestive. There is one period of 6 digits to 7 and one period of 46 digits to 47, and two periods of 138 digits (the halves being complementary) to 329.

The period of $\frac{1}{3\,3\,3}$ is .00303.95136.77811.55015.19756.83890.57750.75987.84194.52887.53799.39209.72644.3768
99696.04863.22188.44984.80243.16109.42249.24012.15805.47112.46200.60790.27355.623i

$$
\begin{aligned}
&\mathbf{1}\\
&\mathbf{10}\\
&\mathbf{100}\\
&\mathbf{13}=7\times 2-1\\
&\mathbf{130}=7\times 20-10\\
&\mathbf{313}=7\times 59-100\\
7\times 24+1=&\mathbf{169}=7\times 26-13\\
7\times 5+10=&\mathbf{45}=7\times 25-130\\
7\times 3+100=&\mathbf{121}=7\times 62-313\\
7\times 30+13=&\mathbf{223}=7\times 56-169=7\times 32-1\\
7\times 18+130=&\mathbf{256}=7\times 43-45=7\times 38-10\\
-7\times 8+313=&\mathbf{257}=7\times 54-121=7\times 51-100\\
7\times 38+1=\ &7\times 14+169=\mathbf{267}=7\times 70-223=7\times 40-13\\
7\times 4+10=-&7\times 1+45=\mathbf{38}=7\times 42-256=7\times 24-130\\
-7\times 7+100=-&7\times 10+121=\mathbf{51}=7\times 44-257=7\times 52-313\\
7\times 14+13=-&7\times 6+223=\mathbf{181}=7\times 62-267=7\times 50-169=7\times 26-1\\
7\times 5+130=-&7\times 13+256=\mathbf{165}=7\times 29-38=7\times 30-45=7\times 27-10\\
7\times 44+313=-&7\times 36+257=\mathbf{5}=7\times 8-51=7\times 18-121=7\times 15-100\\
7\times 7+1=-&7\times 17+169=-7\times 31+267=\mathbf{50}=7\times 33-181=7\times 39-223=7\times 9-13\\
7\times 23+10=\ &7\times 18+45=\ 7\times 19+38=\mathbf{171}=7\times 48-165=7\times 61-256=7\times 43-130\\
-7\times 5+100=-&7\times 8+121=\ 7\times 2+51=\mathbf{65}=7\times 10-5=7\times 46-257=7\times 54-313\\
7\times 44+13=\ &7\times 14+223=\ 7\times 20+181=\mathbf{321}=7\times 53-50=7\times 84-267=7\times 70-169=7\times 46-1\\
7\times 17+130=-&7\times 1+256=\ 7\times 12+165=\mathbf{249}=7\times 60-171=7\times 41-38=7\times 42-45=7\times 37-10\\
-7\times 18+313=-&7\times 10+257=\ 7\times 26+5=\mathbf{187}=7\times 36-65=7\times 34-51=7\times 44-121=7\times 41-100=47\times 4-1\\
7\times 32+1=\ &7\times 8+169=-7\times 6+267=\ 7\times 25+50=\mathbf{225}=7\times 78-321=7\times 58-181=7\times 64-223=7\times 34-13=47\times 5-10
\end{aligned}
$$

$7\times38+10=\ 7\times33+45=\ 7\times15+88=\ 7\times15+171=276=7\times75-249=7\times63-165=7\times76-256=7\times58-130=47\times8-100$

$7\times4+100=\ 7\times1+121=\ 7\times11+51=\ 7\times9+65=128=7\times45-187=7\times19-5=7\times55-257=7\times63-313=47\times3-13$

$7\times20+13=\ 7\times10+223=\ 7\times16+181=-7\times4+321=293=-7\times74-225=7\times49-50=7\times80-267=7\times66-169=47\times7-130$

$7\times42-1$

$7\times14+130=\ 7\times6+256=\ 7\times19+165=\ 7\times7+249=298=7\times82-276=7\times67-171=7\times48-38=7\times49-45=7\times44-10=47\times13-313$

$-7\times42+313=-7\times34+257=\ 7\times2+5=-7\times24+187=19=7\times21-128=7\times12-65=7\times10-51=7\times20-121=7\times17-100=47\times4-169$

$7\times27+1=\ 7\times3+169=-7\times11+267=\ 7\times20+50=-7\times5+225=190=7\times69-293=7\times73-321=7\times53-181=7\times59-223=7\times29-13=47\times5-45$

$7\times35+10=\ 7\times30+45=\ 7\times31+38=\ 7\times12+171=-7\times3+276=255=7\times79-298=7\times72-249=7\times60-165=7\times73-256=7\times55-130=47\times8-131$

$7\times21+100=\ 7\times18+121=\ 7\times28+51=\ 7\times25+65=\ 7\times17+128=247=7\times38-19=7\times45-187=7\times36-5=7\times72-257=7\times80-313=47\times10-223$

$7\times22+13=-7\times8+223=-7\times2+181=-7\times22+321=-7\times18+293=167$ — 6 multiples of 7 $=47\times9-256$

$-7\times15+130=-7\times33+256=-7\times20+165=-7\times32+249=-7\times39+298=25$ $=47\times6-257$

$-7\times9+313=-7\times1+257=\ 7\times35+5=\ 7\times9+187=\ 7\times33+19=250$ $=47\times11-267$

$7\times28+1=\ 7\times2+169=-7\times10+267=\ 7\times21+50=-7\times4+225=\ 7\times1+190=197$ $=44\times5-38$

325 $=47\times8-51$

289 $=47\times10-181$

258 — 7 multiples of 7 $=47\times9-165$

277 $=47\times6-5$

138 $=47\times4-50$

7 multiples of $7+\ldots$ 64 $=47\times5-171$

311 $=47\times8-65$

149 $=47\times10-321$

174 — 8 multiples of 7 $=47\times9-249$

$47\times2+1=$ 95 (the 47th) $=47\times6-187$

$47\times6+10=$ 292 $=47\times11-225$

$47\times4+100=$ 8 multiples of $7+\ldots$ 288 $=47\times12-276$

$47\times5+13=$ 248 $=47\times8-128$

(the 70th) 328 (complementary) $=47\times9-95=47\times7-1$

$7\times6+100=47\times3+1=$ (the 93d) $142=47\times10-328$ (the 70th) $=47\times7-187$ (the 24th) $=7\times65-313$

§ 5. No explanation is here proposed of the following curious property of periods for which q is prime and $a = q - 1$, and is also divisible by 4; so that its universality is not deduced or assumed.

Let a section of m digits of a period be represented by G (1, 2, 3... m), and G(4...m) represent part of the section from the 4th digit to the mth or last digit, and G (1...[m — 6]) represent part of the section from the first to the (m — 6th) digit, and G (x...[$m - y$]) represent a middle portion of the section from the xth digit to the ($m - y$)th digit. Let A $(1...\frac{q-1}{4})$, B $(1...\frac{q-1}{4})$, C $(1...\frac{q-1}{4})$, D $(1...\frac{q-1}{4})$, be the four sections of the period of $\frac{1}{q}$ in order. Arrange A $(1...\frac{q-1}{4})$ followed by C $(1...\frac{q-1}{4})$ over B $(1...\frac{q-1}{4})$, followed by D $(1...\frac{q-1}{4})$, making two ranks of digits, and add; then the sum E $(1...\frac{q-1}{2})$ will contain in order $\frac{q-1}{2}$ of the digits of the period. If, however, $q - 1$ be a multiple of 10, E $(1...\frac{q-1}{2})$ will contain only $\frac{q-1}{2} - 2$ of the said digits.

EXAMPLES.

For $\frac{1}{17}$ 05889411
23527647

29417058

For $\frac{1}{29}$ 03448274137931
58620689655172

62068963793103

For $\frac{1}{61}$ 016393442622950180327868852459
819672131147540983606557377049

836065573770491163934426229508

As this property is not shared by periods of q when n does not $= 1$, it cannot be altogether due to the halves of the periods being complementary. It appears to be due to the arrangement of all the periods of q under one cycle of digits.

§ 6. It is noteworthy that the only completely cyclic *number* is 142857.

For $142857 \times 2 = 285714$
" $\times 3 = 428571$
" $\times 4 = 571428$
" $\times 5 = 714285$
" $\times 6 = 857142$
" $\times 7m = m\,(10^6 - 1)$.

Hence, to multiply 142857 by any number, $7m + n$ (where $n = 1$ or 2 or 3 or 4 or 5 or 6), we have only to divide the multiplier by 7, thus finding m and n, prefix m to $142857 \times n$ and then subtract m.

Thus to find $(142857)^2$

$$7)142857$$
$$20408 - 1$$
$$20408122449 = (142857)^2.$$

Also, $2915446064142857 - 2915446064 =$
$2915443148696793 = (142857)^3$

Stated Meeting, October 18, 1901.

Vice-President WISTAR in the Chair.

Present, 9 members.

Mr. Thomas Willing Balch, a newly elected member, was presented to the Chair, and took his seat in the Society.

The list of donations to the Library was laid on the table and thanks were ordered to be returned for them.

With reference to one of the donations, Dr. Hays called attention to a statement contained in Mr. William Eleroy Curtis's *True Thomas Jefferson*, just published, that this Society possessed Jefferson's " original draft " of the Declaration of Independence, with all the corrections. He thought it important that this statement should not remain uncorrected, as it might lead to considerable disappointment. The copy

in Jefferson's handwriting possessed by this Society is one of several made by Jefferson between the 4th and 10th of July, 1776, to send to friends, that they might compare the Declaration as originally framed and reported by the Committee with the document as amended and passed by the Congress, and "judge whether it is better or worse for the critics," as he expressed it in his letter of July 8, 1776, sending the copy in question to Richard Henry Lee, from whose grandson this Society received it. A history by Dr. Hays of this copy is printed in Vol. xxxvii of the Society's *Proceedings*.

The meeting was adjourned by the presiding officer.

Stated Meeting, November 1, 1901.

Vice-President BARKER in the Chair.

Present, 20 members.

Dr. Mazÿck Ravenel, a newly elected member, was presented to the Chair, and took his seat in the Society.

A letter was read from the Société Nationale des Sciences Naturelles et Mathématiques de Cherbourg, announcing that it would celebrate its fiftieth anniversary on December 30, 1901, and the Secretaries were instructed to send a congratulatory address to the Society.

The list of donations to the Library were laid on the table, and thanks were ordered for them.

Mr. James Douglas presented a "Record of Borings in the Sulphur Spring Valley, Arizona, and of Agricultural Experiments in the Same Locality."

Prof. George F. Barker, delegate to the 200th anniversary celebration of Yale University, presented a report with a medal struck in honor of the anniversary.

Prof. Albert H. Smyth, delegate to the 450th anniversary celebration of the University of Glasgow, presented a report.

The meeting was adjourned by the presiding officer.

RECORD OF BORINGS IN THE SULPHUR SPRING VALLEY, ARIZONA, AND OF AGRICULTURAL EXPERIMENTS IN THE SAME LOCALITY.

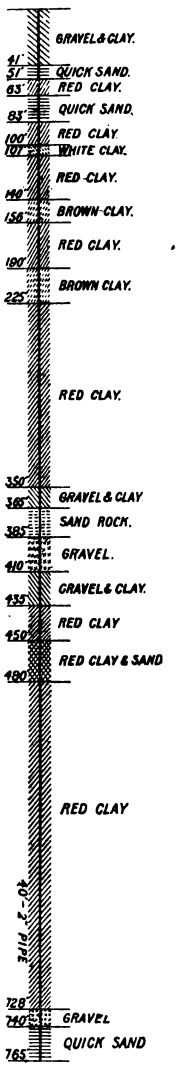
BY JAMES DOUGLAS.

(*Read November 1, 1901.*)

The Copper Queen Consolidated Mining Company has since 1880 worked extensive copper deposits in what are probably carboniferous limestones, lying on the eastern flank of the Mule Pass Mountains, in Cochise county, Arizona, within a few miles of the Mexican boundary and 5700 feet above the sea. The geology of the region east of the Mule Pass Mountains renders it probable that there are Jura-Triassic strata lying unconformably over the carboniferous limestones, and that within the Jura-Triassic there may occur coal. Where coal occurs in Northern Sonora, to the south of the great Sulphur Spring Valley, and in Arizona, to the north of that valley, the beds are so shattered by intrusive rocks as to detract largely from their commercial value. But beneath the broad Sulphur Spring Valley we considered it possible that there might be undisturbed coal beds of sufficient extent to warrant their exploitation. With the object of determining this, the Copper Queen Company drove a diamond drill hole in the trough of the valley. The attempt was abandoned before solid rock was reached. The diamond drill penetrated the alluvium, as shown by the following record of borings, for 765 feet without reaching solid rock. The record is interesting as showing the extent of erosion and the depth to which the valleys are filled by detritus in the arid region.

At the same time, the Copper Queen Company, being anxious to develop every possible industry in connection with their mines, and as a feeder of their railroad, instituted some systematic agricultural experiments on a tract of land lying in the trough of the same Sulphur Spring Valley. The valley extends in a general north-and-south direction for about one hundred and twenty miles, and, with very gradually sloping sides, has an average width of about twenty miles. It is surrounded to the north, east and west by high arid mountain ranges, on which the average annual rainfall is ten inches. While a certain proportion of this moisture escapes by evaporation, the larger portion sinks through the porous soils and collects as a

subterranean reservoir in the basin-shaped valley, which has a very gentle fall to the south, and therefore discharges some of its water contents, by the subterranean stream of the Agua Prieta, into the headwaters of the Yaqui river. The water in abundance is struck at from nine to thirty feet below the surface almost anywhere in the trough of the valley; and experiments extending over three years showed that ten acres of fruit trees can be irrigated by twenty-foot windmills, provided adequate reservoirs are provided. If, therefore, a valuable product, such as fine fruits, could be raised under the climatic conditions prevailing, the question of power for artificial irrigation may be regarded as solved. The attempt, however, to cultivate semi-tropical fruits failed, principally through the extraordinary variations of temperature.



SECTION — DIAMOND DRILL HOLE IN THE SULPHUR SPRING VALLEY, ARIZONA.

During the term of the experiment a thermometrical record was kept on the ranch, which is printed below in parallel columns with a record for the same period kept at Bisbee. This mining town is situated in a deep ravine in the Mule Pass Mountains, which flank the Sulphur Spring Valley on the west, 1200 feet above the level of the valley, but where, despite the higher altitude, the diurnal variations in the annual experiments are less than in the valley itself. These great sandy valleys in the Southwest, covered at best with a scanty growth of mesquite, and during the greater part of the year by scorched grass, permit of such rapid radiation through the cloudless heavens, that the burning heat of the day falls, immediately the sun sets, to a temperature which is sensibly chilling, and which therefore has a seriously detrimental influence on delicate vegetation. Were these vast valleys simultaneously cultivated and clothed with verdure, this climatic obstacle to agriculture would be reduced, as is the case in the Salt River Valley, where an area of large enough extent is under cultivation to almost relieve the rancher

from the risk of spring frosts. In the fruit culture experiments made the extreme cold occasionally registered in January did not seem to injure even such delicate trees as the almond, due doubtless to the absolute aridity of the soil and the air. But the trees broke into bloom in February, and the fruit was fully formed when April frosts destroyed it year after year. The terrific midday heat of summer days would also cause a plant apparently healthy in the morning to wither and die before evening, although the root was thoroughly irrigated.

The result of our experiments led us to believe that these broad valleys, which originate in Southern New Mexico and Arizona and stretch into Northern Mexico, though arid at the surface, have at comparatively shallow depths a subterranean water supply sufficient to irrigate their very large areas of very rich land; that the winds are sufficiently strong and constant to raise the water to the surface, through the agency of windmills, for the irrigation of fruit trees on farms large enough to occupy the energies of single ranchers; that the climatic conditions are the principal hindrances to the success of that branch of agriculture; but that if coöperative efforts were made to cultivate very large tracts, these climatic conditions would be so modified as to render the cultivation of these vast tracts possible and profitable.

Maximum and Minimum Temperatures,

taken in the Sulphur Spring Valley, at 4500 feet above sea level, and at Bisbee, at 5700 feet above sea level, both localities being in the same latitude and twenty miles apart.

	Temperature in Sulphur Spring Valley.				Temperature at Bisbee.			
	Average.				Average.		2 P.M.	
1891	Max.	Min.	Max.	Min.	2 P.M.	Min.	Max.	Min.
March	72.9	33.1	91.	16.	63.	39.5	76.	25.
April	83.4	36.2	98.	24.	72.9	46.1	83.	36.
May	88.7	43.2	96.	34.	77.4	52.6	84.	41.
June	98.7	51.8	109.	40.	85.9	60.4	96.	48.
July	103.1	63.1	107.	55.	91.2	68.3	98.	62.
Aug.	94.3	61.	105.	56.	83.	68.4	97.	60.
Sept.	94.4	52.6	102.	38.	84.2	60.3	91.	50.
Oct.	84.5	41.4	91.	30.	79.6	49.6	97.	42.
Nov.	72.3	29.4	83.	19.	70.3	44.7	80.	34.
Dec.	57.2	15.4	74.	1.	54.6	31.6	70.	15.
1892								
Jan.	61.4	21.6	74.	6.	58.5	34.7	74.	20.
Feb.	65.8	29.7	80.	19.	56.7	36.2	70.	21.
March	68.8	30.6	87.	20.	62.3	40.4	77.	32.
April	78.	33.4	91.	19.	71.5	48.2	84.	32.
May	88.	39.6	97.	28.	78.3	53.	92.	40.
June	96.5	47.1	105.	29.	88.8	61.2	99.	45.
July	97.3	60.6	102.	50.	89.5	67.4	96.	62.
Aug.	95.4	56.3	102.	47.	85.8	64.3	96.	58.
Sept.	91.3	46.5	99.	34.	86.2	61.9	94.	56.
Oct.	80.7	36.	91.	22.	72.3	49.3	86.	30.
Nov.	69.	30.7	78.	24.	66.5	42.5	75.	36.
Dec.	58.1	20.9	75.	6.	56.1	36.9	72.	21.

Diurnal Variation.

Average diurnal maximum	92.6	Average diurnal maximum	85.8
" " minimum	28.4	" " minimum	39.3
Difference	64.2	Difference	46.5

Stated Meeting, November 15, 1901.

Vice-President SELLERS in the Chair.

Present, 16 members.

Dr. Simon Flexner, a newly elected member, was presented to the Chair, and took his seat in the Society.

A letter was read from the Secretary of the "Délégation pour l'adoption d'une Langue Auxiliaire Internationale," inviting the Society to participate in its work and appoint a collaborator.

A list of donations to the Library was laid on the table, and thanks were ordered for them.

Prof. George F. Barker made some remarks on "The Monatomic Gases of the Atmosphere," and exhibited tubes of Neon, Krypton and Xenon, prepared by Prof. Dewar, of the Royal Institution.

The meeting was adjourned by the presiding officer.

Stated Meeting, December 6, 1901.

Vice-President BARKER in the Chair.

Present, 23 members.

The Librarian laid upon the table the list of donations to the Library and thanks were ordered therefor.

Dr. George F. Barker read a memoir of the late Prof. F. A. Genth.

The death of the following members was announced:—

Dr. John Curwen, at Warren, Pa., July 2, 1901.

Dr. W. F. Norris, at Philadelphia, November 18, 1901.

Mr. Thomas Meehan, at Philadelphia, November 19, 1901.

Mr. Percival Lowell, of Flagstaff, Arizona, read a paper on "Explanation of the Supposed Signals from Mars of December 7 and 8, 1900."

The following annual reports were read :—

The report of the Treasurer.

The report of the Curators.

The report of the Hall Committee.

The report of the Publication Committee.

The report of the Library Committee.

The meeting was adjourned by the presiding officer.

EXPLANATION OF THE SUPPOSED SIGNALS FROM MARS OF DECEMBER 7 AND 8, 1900.

BY PERCIVAL LOWELL.

(*Read December 6, 1901.*)

1. On a certain morning in December, 1900, paragraphs appeared in the papers throughout the United States with the startling announcement that Mars had been signaling the Earth the night before. Lights, it was reported, had suddenly shone out upon the surface of the planet, lasted for a time and then vanished. What the signals meant was not so forthcoming. Vividness of headline made up for meagreness of news.

Interest was not confined to the United States. Reportorial inquisitiveness was as rife in the Old World as in the New, and Europe was behind America in the receipt of the message only the time necessary for its transmittal.

2. To broaden one's horizon is a good thing; and to broaden it beyond the bounds where horizon itself disappears, a still better one. But the broadening is apt to come not in a way we expect, and to prove the more broadening for that reason. I hope, therefore, not seriously to lessen interest in the phenomena by saying that they were certainly not what they were popularly taken to be, and were with equal certainty much which was not supposed and is quite as interesting.

The innocent cause of the misrepresentation was a dispatch sent

from Flagstaff to the writer and communicated by him through the usual channels to the astronomical world. The signaling part of it was a tale added by journalistic ingenuity at the time that profession became possessed of the subject. The original dispatch read:

"Projection observed last night over Icarium Mare, lasting seventy minutes."
(Signed) "DOUGLASS."

3. Projections in the case of one heavenly body, the Moon, are not unfamiliar objects. On almost any night when that body shows a terminator, that is a sunset or sunrise edge, a keen eye can detect one or more of them along it without telescopic aid. With Mars the phenomenon is much less common and, though many such projections have in the last few years been seen upon the planet, the sight is one of some rarity.

4. In the case of the Moon it is possible to find out the cause of the projections. By magnification through a telescope the little knob that breaks the otherwise uniform boundary of light and shade is seen to resolve itself into the tip of a mountain peak or the summit of a crater wall, which catches the light while the lower ground at its foot is plunged in shadow, and so seems to project beyond the rest of the disk. With Mars no such forthright determination of the problem is possible. For no magnification we can apply is potent enough to disclose of itself the character of the country. We are, therefore, obliged to reason upon what we see.

5. Taking lunar analogies for guide, it was generally inferred that the martian projections too were due to mountain peaks. From which of course it followed, or as one may say preceded, that there were mountains on Mars. But the Flagstaff observations of 1894 showed that, on general principles, this was very improbable. The study of the surface markings led the writer to a general theory about the character of the planet, in which mountains not only found no place but to which they were decidedly opposed. At the same time that the theory suggested itself, but independent of it, Mr. Douglass observed several projections, and conceived and published another explanation for them, and this one proved consonant with what the theory demanded, to wit: that, instead of being due to mountains upon the planet's surface, they were due to clouds floating in the planet's air. He showed that the observations were thus much better explained; in fact, that his observations could hardly be accounted for with probability on the mountain hypothesis at all

6. The opposition of 1894 was very prolific of projections, over four hundred being seen at Flagstaff in the course of nine months. The next opposition was not so good; while in that which has just passed, that of 1900–1, only two were detected. It was these two which gave rise to the notion of signals from the planet.

Now the variability in the number seen at different oppositions should have materially shaken faith in the mountain explanation. Mountains are permanent affairs, and if they be high enough to catch the light and show as protuberances at one time they should do the like at another. The change in the inclination of the disk would not materially alter their visibility. But it is one of the humorous anomalies about human nature that general reasoning affects minds so little when applied to unfamiliar matters, while in familiar ones it is the guiding principle of life.

7. Argument from the two projections of the last opposition is, on the other hand, particular. Although they were but two in number, testimony in the case is very much to the point. Indeed, their isolated character helps to make their cogency the clearer.

On December 7, at 16h. 15m. S. M. T., Mr. Douglass suddenly noticed a projection on the terminator of the planet, a little to the north of the Sabæus Sinus. The phase loss at the time was 36°.4. As he continued to watch it the projection increased. The distance of its tip from the edge of the terminator passed successively through the values ⅔, 1, 1⅓ and 1½ of a thread; the thread used being the stationary spider's thread of the micrometer. Meanwhile he was busy taking the position angle of the tangent to the terminator, at the point directly under it, at intervals of a few minutes. His observations, recorded in detail in the observing book, are as follows:

RECORD OF DECEMBER 7, 1900.

Th. = thread; P.A. = position angle.

1900.

Dec. 7, 16h. 15m. Projection over Sinus Sabæus; P.A. tang. to terminator 183°.2

22m. Projection continues (sketch). Height = ⅔ Th.

24m. P.A. terminator tang. 185°.5.

26m. P.A. terminator tang. 184°.3.

30m. Projection continues; ½ to ¾ Th. in height.

34½m. P.A. terminator tang. 182°.4.

37½m. Ht. 1 Th.; no other irregularities on terminator.

39m. P.A. 182°.0.

41m. P.A. 184°.7.

Dec. 7, 16h. 42½m. Rather bright on terminator near north cap at P.A. 238°.0.
44m. Projection continues; terminator otherwise regular.
46m. P.A. 183°.8.
51m. (After spell of seeing o) projection then of this form: (sketch). Height 1⅓ Th.
P.A. 183°.9.
55m. Projection there; flatter?
59m. Projection there; flatter?
17h. 6m. Projection there (after spell bad seeing) (sketch); possible separation. Height 1½ Th.
P.A. 186°.2.
19m. Think projection is very small; at times thought it gone. Now ⅓ Th. (sketch).
22m. Projection certainly there; I get this form: (sketch) Sinus Sibæus? Very low, say ¼ Th.
P.A. 185°.3.
30m. Think the projection has gone or else it is very slight; if it is there its P.A is 186°.0.
35m. Projection undoubtedly gone.

8. On the next night he found the terminator perfectly regular until 15h. 44m. S. M. T., when he recorded: Terminator regular, but suspicious white N. of Icarium Mare. Icarium Mare is a name given to the dark marking running from the forks of the Sabæus Sinus to the Hammonis Cornu, and formerly included under the general designation of the Sabæus Sinus. Four minutes later he noted: Projection just started N. of Icarium Mare. There then followed an almost exact repetition of the previous night's experiences, as will be seen from the transcript of the observations.

RECORD OF DECEMBER 8, 1900.

Th. = thread; P.A. = position angle.

1900.
Dec. 8. 15h. 44m. Terminator regular, but a suspicious white N. of Icarium Mare.
48m. Projection just started N. of Icarium Mare.
50m. At P.A. 186°.3. Ht. ½ Th.
All, so far, was with eyepiece .89.
I now put in ¾ ep.
58m. Projection more conspicuous. Ht. ⅔ Th.
P.A. 184°.8.
16h. 02½m. Projection. Ht. ⅔ Th. shows more easily in this ep. than .89.
16m. Projection at P.A. 187°.7; seeing good for limb and terminator.

Dec. 8, 16h. 20m. The projection looks separated from term.; seeing not good enough to assume this (sketch).

25m. Projection looks separated in good seeing. Ht. 1½ Th., and half of this is separated (sketch).
P.A. 188°.1.

34m. Projection P.A. 187°.0; in ½ inch; seeing poor.

44m. Projection probably there at
P.A. 187°.7, and of this form (sketch) and faint; seeing is constantly too poor to judge well.

47m. Projection; think it is there as described. The terminator has been otherwise regular at all observations.

50m. Seeing 1–2. Think projection is there, low and faint, and also a whitish region on adjoining disk.

9. On reducing and comparing the observations of the two nights, it appears at once that they do not refer to the same point or points upon the planet. On the first night, at the time of the appearance of the projection, the longitude of the centre of the disk was 26°, at the time of its disappearance 44°, while on the next evening the longitudes were respectively 10° and 25°. Not only were the two positions not the same, but they were separated from one another by at least sixteen degrees of longitude.

10. On looking up the records of the first night, it appears that the planet, previous to the detection of the projection, was under continuous observation from 14h. 10m. to 15h. 45m. S. M. T., or from the time the longitude of the centre was 355° to the time it was 18° During this interval there are two specific records that the terminator was free from irregularity, one at 14h. 31m., the other at 14h. 45m.; and from the nature of the observations it is presumable that any projection occurring in the interval would not have escaped notice. We may then fairly infer that the projection seen on December 8 did not exist in that position on December 7.

11. On December 8 observations ceased at 16h. 50m., but on the 12th of the month the terminator was carefully scrutinized from longitude centre 298° to longitude centre 13° at intervals, such that no projection of the duration of those of the 7th and 8th could have passed it without being seen. No irregularity was detected. The projection of December 8, therefore, did not exist *in situ* on the 12th.

12. Furthermore, when the rotations of the planet and the Earth brought the two bodies again into corresponding positions at corresponding hours on January 12, the terminator was scanned by Mr. Douglass from 13h. 48m. to 15h. 35m., or from longitude centre 15°

to longitude centre 41°, without revealing any irregularity. The phase loss was then 27°, as against 36° in December. So that nine degrees should be deducted from these figures to make them comparable. It thus appears that on this date both projections should have been visible, one after the other, had they still existed. Neither was seen. Nor was any projection seen at any other time during the opposition. Permanences like mountains, therefore, could not have caused them without doing violence to the observations.

From the impermanency of place of the projections it is clear that they could not have been fixed to the planet's surface—that is, they could not have been mountains. We are left, therefore, with the alternative that they were a something floating in the planet's air capable of reflecting light, or in other words clouds. Secondly, from the similarity of their appearances, we infer that they were the same clouds which had shifted their position during the twenty-four hours that elapsed between their apparitions. They may, of course, have been wholly distinct condensations of vapor which happened to agree in behavior. The probability of this we shall now investigate by considering the phenomena more in detail.

13. It is necessary to begin by determining their height, for it will be found that this height enters as a function into the equations of position. If we call

d = the perpendicular distance of the tip of the projection from the terminator;

$P—P.A. = \varphi$ = angle between the tangent to the terminator and the axis of rotation;

E = the angle of the phase;

A = the phase latitude, that is the latitude reckoned from the phase equator;

a = the radius of the disk in seconds of arc;

a_0 = the radius of the planet in miles;

x = the angle subtended at the centre of the disk between the tip of the projection and the point on the terminator at the same phase latitude,

we shall have

$$\tan x = \frac{d}{\cos \phi \sin E . a . \cos A}$$

and h = height will be

$$h = \sec x - 1 . a_0 \cos^2 A$$

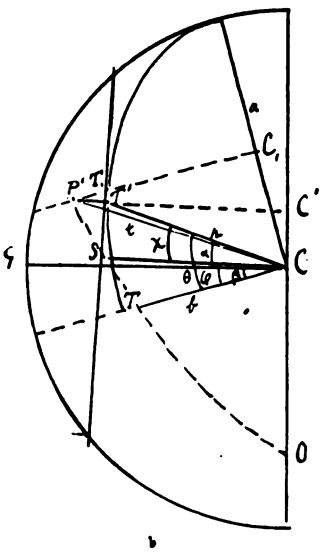
Performing the numerical operations, we find for the height on December 7,

$$h = 13.4 \text{ miles.}$$

and on December 8,

$$h = 13.6 \text{ miles.}$$

14. For the calculation of position we proceed as follows:



b

$$\tan\theta = \frac{a^2}{b^2}\tan\varphi \qquad \chi = \theta - \varphi$$

$$r^2 = \frac{a^2}{\sin^2\theta + \frac{a^2}{b^2}\cos^2\theta} \qquad \alpha = \theta - \beta$$

$$C = 90° + \alpha - TCP'$$

$$t^2 = r^2 + h^2 + 2rh\cos\chi$$

$$\frac{\sin TCP'}{\sin\chi} = \frac{h}{t}$$

Let θ = angle which the line from the centre of the phase ellipse to the point upon the terminator perpendicularly under the projection makes with the minor axis of that ellipse. Let r = distance from the centre of the disk to this point. The minor axis has for value $r \cos E$, the major axis being r. By a property of the ellipse we have

$$\tan\theta = \frac{a^2}{b^2}\tan\phi = \sec^2 E \tan\phi$$

from which we find θ. To find r we have from the equation of the ellipse

$$r^2 = \frac{a^2}{\sin^2\theta + \frac{a^2}{b^2}\cos^2\theta}$$

from which, knowing θ, the value of r follows.

The distance t from the centre to the tip of the projection may now be got by solving the plane triangle whose sides are d, r and t. For d is given, r is now known and the angle included between them is $180° - \chi$ where

$$\chi = \theta - \phi$$

and this also is known.

t would give us the projected place upon the visible disk of the tip of the projection, if the projection were on the surface of the planetary sphere. As it is in reality raised above it, we must apply a correction depending upon the height of the projection. It is for this reason that the height must first have been found. Perhaps the neatest way is the one adopted by Mr. Manson, who performed the numerical computations, that of simple projection, which gives

$$t_1 = \frac{a}{a+h}\, t$$

Knowing t and also the angle in the plane triangle opposite the side d, which we may call D, we have a spherical triangle for the determination of the latitude and longitude of the point on the sphere directly under the projection. In this triangle we know the side t, whose value in angular measure is $\cos t$; the side $(90° - B)$, which is the angle between the pole of the planet and the centre of the disk; and the angle between the two, which is

$$\begin{aligned} C &= 90° - (Q - 270° - P) + \theta - D \\ &= P - Q + \theta - D \end{aligned}$$

where P and Q have the meanings of Crommelin's ephemeris for the planet.

We then have the latitude, l_1, from

$$\cos l_1 = \cos t_1 \sin B + \sin t_1 \cos B \cos C$$

and the longitude, λ, from

$$\frac{\sin(\lambda - \lambda_1}{\sin C} = \frac{\sin t_1}{\sin T_1}$$

The results are:

PROJECTION DECEMBER 7, 1900.

TABLE I.

Date.	*h.*	*m.*	*P.A.*	*d.*	*Lat.*	*Long.*
Dec. 7.....	16	15	183°.2	⅓ thread	—4°.7	333°.1
	17	06	186°.2	1½ "	—3°.6	339°.4
	17	19	186°.1	⅓ "	—1°.5	347°.4
	17	30	186°	0 "	—1°.0	351°.4

and for

PROJECTION DECEMBER 8, 1900.

TABLE II.

Date.	*h.*	*m.*	*P.A.*	*d.*	*Lat.*	*Long.*
Dec. 8.....	15	50	186°.3	½ thread	—1°.9	315°.2
	16	25	188°.1	1½ "	—1°.4	319°.5
	16	44	187°.1	½ "	—0°.8	328°.5

15. The numerical value of d was got as follows: Mr. Douglass' micrometric measures of the spider's thread were obtained by moving the movable thread from contact on the one side of the stationary thread to contact on the other. This gave 0″.22 for the width of a thread.

In the estimating of the distance d the thread was placed against the background of the disk. As a measure of width it was therefore its true width less the irradiation into it from both sides. The value of this irradiation was determined by the following device which occurred to me, and which if accurately made should give the irradiation absolutely. From the point of contact the thread is moved till the bright background seems equal to the width of the thread. We then have the following equation, in which

a = width of thread.
b = width moved from contact to one apparent thread apart.
x = the irradiation.

$$a - 2x = b + 2x.$$

or

$$x = \frac{a - b}{4}$$

b proved = 0″.14

whence the effective width of the thread was 0″.18.

The P.A.'s used were got either directly or by plotting all the P.A.'s taken and then drawing the centre of gravity line between them.

16. The first thing that appears from the tables is that the observations cannot be satisfied by the supposition of one cloud alone on either day. It is necessary to suppose two on each occasion, a high cloud followed by a much lower one. The height of the lower cloud was about three to four miles, and it lay to the west and north of the main one.

The eastward end of the main cloud on December 7 was in latitude 4°.7, longitude 333°; its westward end in latitude 3°.6, longitude 339°. So that the cloud either stretched this distance or moved over it in the interval. From the great speed required it is unlikely that the cloud actually travelled this distance in this time. If translation took place at all, it was probably the translation of propagation. But, from the phenomena of the next night, it would seem more likely that the cloud really stretched over 6°, or 220 miles. Its breadth was ½ thread or 0″.09, which is forty-five miles.

The dimensions of the subsidiary cloud, or subsidiary portion of the main cloud, are much more conjectural. It would seem to have been of about the same extent as the main body.

On December 8 the main cloud was slightly less long but broader than it had been on the preceding night; the subsidiary patch was not much changed. But both clouds had in the interval drifted 17° to the eastward and 3° or so to the north. Whether, therefore, the clouds were being propagated or not in a west-by-north direction each night, it would seem that either they or the stratum of air which generated them was drifting east by north at the rate of 17° + in twenty-three and a half hours, or at the rate of twenty-seven miles an hour.

17. Looking back now, with this motion in mind, in the records of the 12th December, § 11, we find that the place the clouds should have occupied on that date (longitude centre 302°—317°), if the same translation had been kept up, was under careful observation for such phenomena and nothing whatever was seen. Indeed, so comprehensive in extent were the observations, that any less speed of translation should also have caused the clouds to fall within the limits of inspection, and even a somewhat greater speed should have done so too.

On the 13th the place they should have reached was scrutinized. The observations covered from longitude centre 280° to 208°. Nothing showed. The same was done on the 15th, longitude centre 276°–285°.

We may conclude, I think, that the cloud formation had dissipated at some time between the 8th and the 12th.

18. The season of the martian year at which these clouds occurred is of interest. On December 7, 1901, it was April 26 in the northern hemisphere of Mars. The sun had gone north of the equator and was then overhead on the fourteenth parallel of latitude. The heat equator was a little behind it. Apparently then a current bearing the clouds was setting toward the heat equator from within the tropics to the south, where the season corresponded to the end of October. This current was deflected some eighty degrees to the east, and became an east-by-north wind.

19. Its origin may have been local. A little to the south of where the cloud first appeared lies the long east-and-west stretch of the Sabæus Sinus or Icarium Mare. Now the form of the cloud was of the same general shape—a cloud stretching east and west five times as far as it did north and south. The Icarium Mare is undoubtedly a great tract of vegetation, where moisture would be held and whence it could accordingly be given off. Arising there, either from seasonal or temporal cause, the vapor would gather into a cloud and proceed to float away over the desert regions to the north. If this, then, is what happened in the case before us, we may conceive the cloud as having been generated on the 6th of December over the Icarium Mare, rising to a height of thirteen miles, and then traveling east by north at about twenty-seven miles an hour off into the desert of Aeria, there to dissipate after an existence of three or four days. That it was a phenomenon of capricious not of regular production is shown by its not having been repeated—that is, it partook of the subtle unpredicability of cloud.

Stated Meeting, December 20, 1901.

Vice-President SELLERS in the Chair.

Present, 30 members.

Mr. C. Stuart Patterson read a memoir of the late Hon. Frederick Fraley, LL.D., President of the Society.

The meeting was adjourned by the presiding officer.

OBITUARY NOTICES OF MEMBERS DECEASED.

FREDERICK FRALEY, LL.D.,

PRESIDENT OF THE SOCIETY.

(*Read December 20, 1901.*)

Frederick Fraley, the fifteenth President of the American Philosophical Society, died on the 23d day of September, 1901, in the ninety-eighth year of his age. He had been an active member of the Society for more than fifty-nine years. After long service as a Secretary and as a Vice-President, he, on 2d January, 1880, received the merited honor of an election to the Presidency, and for more than twenty-one years he administered that office of great distinction, as he performed every duty, with fidelity and ability.

He brought to the discharge of his many duties a wide acquaintance with books, with men, and with affairs.

He was always, and to the very end, a student and an omnivorous reader. To paraphrase a famous saying, nothing was too great for his care and nothing too trivial for his attention. He mastered the political, the economic, and the industrial history of his country. He made himself profoundly learned in everything that could possibly have relation to the national finances, and he became a reservoir of accurate and thorough information as to the loans and the currency of the United States. He kept himself in touch with the scientific progress of the nineteenth century. He read not only many of the best books of his time, but he also from time to time found, as many other men have found, mental rest and recreation in works of fiction, old and new. And with it all, he never failed to hear the news of the day and to feel and express a lively interest in everything of real importance that went on in the world.

Mr. Fraley was a member of the Committee of Arrangements for the Society's Centennial Celebration of 1843. On 19th October, 1877, he read before the Society a brief but comprehensive and sympathetic biographical notice of his brother-in-law, John C. Cresson. On 15th March, 1880, he presided upon the occasion of the Centennial Anniversary of the Incorporation of the Society, and he then delivered an address, in which he fittingly described

the services to the Society which had been severally performed by each of his fourteen predecessors in the Presidency, with all of whom, excepting the first three, he had been personally acquainted, and with the last six of whom he had been upon terms of intimate friendship. On 3d November, 1882, he contributed to the Society's PROCEEDINGS a minute upon the Bi-Centennial Celebration of that year. On 21st November, 1889, he presided over the Society's commemoration of the Centennial Anniversary of the occupation of its present hall, and he delivered an instructive address, in which he briefly commented upon the most important points in the history of the Society. On 17th April, 1890, on the occasion of the Centennial Anniversary of the death of Benjamin Franklin, he eulogized the illustrious founder of the Society. On 23d May, 1893, the one hundred and fiftieth Anniversary of the Founding of the Society, Mr. Fraley presided and delivered graceful speeches welcoming the guests of the Society.

Mr. Fraley attended the meetings of the Society with, as he said, "reasonable regularity" until, in his later years, physical infirmities deprived him of that pleasure. He had, from the time of his admittance to the Society, a pride in its history and achievements, a full appreciation of its lofty purposes, and a confident hope that it will, as he expressed it in his speech of 1889, "Rouse itself up with energy to the work that is demanded of it at the present time and use the means and the influence that it has, and the power that it ought to exercise, in the community for the promoting of everything connected with usefulness to man—everything that will tend to improve his moral and intellectual character, and everything that will enable him to rise with higher appreciation to what is good."

Mr. Fraley said, in his address of 1889, "If I have had any useful career in life, I owe much to what I have learned in the Franklin Institute and in the American Philosophical Society." In his earlier years his participation in the proceedings of the Franklin Institute gave him a love of study and an interest in the scientific and industrial progress of the world. In the years of his maturity his mind w broadened by his association with the men who then constituted the membership of this Society, and with them he learned to "love truth for truth's sake."

Mr. Fraley was for eighty years an active man of business. After a preliminary training in a store, he was for fourteen years a

partner in a mercantile firm. He was for seven years the Secretary of the American Fire Insurance Company. He was for twenty-three years the President of the Schuylkill Navigation Company, which during that period operated its canals as successfully as could be in the face of active and increasing railroad competition. He was, during the years of preparation, the brief six months of exhibition, and the subsequent years of liquidation, the Treasurer of the Centennial Board of Finance, and as such he was the custodian and disburser of the many millions of dollars which were received and expended in the successful conduct of the great Exhibition of 1876. For the last twenty-three years of his life he was the President of the Western Saving Fund Society, and during the years of his wise administration the deposits of that Society grew from less than three millions of dollars to almost sixteen millions of dollars and its assets increased in a larger proportion.

Mr. Fraley possessed in a high degree the qualifications that are desirable in the official head of a corporation that has charged itself with the duty of keeping safely the moneys of its depositors, and which does not have shareholders for whom dividends are to be made. He had an ever-present conscientious sense of duty to those to whom the corporation stands in a fiduciary relation. He had that conservative temperament which indisposed him to risk anything in a doubtful investment, however tempting its promises of profits. While during his later years he may sometimes have seemed to be too cautious, it was, if an error, certainly an error upon the right side. He knew thoroughly the history and the principles of the science of finance. He could weigh with discriminating judgment the reasons for or against any particular course of action. He could say "No," pleasantly but firmly. Down to the last day of his active business life, and that was as recently as the tenth day of the May preceding his death, he could not only, as is usual with very old people, remember the events of long ago, but he could report accurately and in detail discussions and conclusions of recent days. He was especially remarkable in a difficult exercise of memory, in that he was accustomed to calculate by mental arithmetic the annual yield of an investment bought at a premium and with a postponed maturity. For the accomplishment of that result men of a less mathematical turn of mind, and with a weaker memory, habitually use printed tables prepared for that purpose. Mr. Fraley had early in life formed the habit of precise and

accurate statement, and he never, to the knowledge of those who were closely associated with him, made a mistake in mentioning a name or a figure. This too must be said: Mr. Fraley was to his subordinates the most delightful of chiefs. He was uniformly courteous and considerate under circumstances pleasant or trying, and he was always anxious to give to any one who served under his command more than full credit for whatever was done.

But neither the daily work of business, nor the delights of literature, nor active participation in the duties and the pleasures of this Society could sufficiently absorb Mr. Fraley's energies. In 1824 Mr. Fraley was one of the founders of the Franklin Institute, and for seventy-seven years he was an active member of that Society of world-wide reputation and distinguished achievements, whose doors have been always open to receive students of science and the useful arts. In 1853 Mr. Fraley took his seat as a Trustee of the University of Pennsylvania, and during his forty-eight years of service that great institution of learning has, by reason of the earnest efforts of its successive Provosts, Trustees, and instructors, the loyal support of its Alumni, and the generous gifts of money by the broad-minded men and women who have written their names upon the roll of the benefactors of the University, become the centre of the intellectual life of Philadelphia and one of the foremost colleges of the country.

Dr. William Pepper, to whom this Society and the University owe debts which never can be paid, said of Mr. Fraley, that during more than forty years "he had been prominently engaged in all the efforts which had brought the University to the prosperous and powerful position she now commands. He enjoyed in a rare degree the love and confidence of Trustees and Faculties, and no language could convey an adequate sense of the value of his benignant influence, of his universal charity, of his wise counsels, and of his constant loyal co-operation. I am confident the University never had a truer friend, nor a more faithful and unselfish servant."

Mr. Fraley was in 1833 a founder, and for sixty-eight years a member, for sixty-seven years a Director, and for fourteen years the President of the Philadelphia Board of Trade, which, under his leadership, has devoted itself to the improvement of facilities for transportation by land and water, to the increase of commerce, to the growth of manufactures, to the maintenance of a solid financial

system, and, in Mr. Fraley's words, to "the development of those impersonal interests that make the prosperity of a great city."

Upon the formation, in 1868, of the National Board of Trade as a federation of all the commercial organizations of the country, Mr. Fraley was chosen as its President, and for thirty-three years he was successively re-elected to that high office by the unanimous action of delegates coming from every part of the country, and bound to him by no tie other than a just appreciation of his character, ability, and impartiality.

In all of the many bodies, corporate or voluntary, public, business, or social, over which Mr. Fraley presided, or in whose deliberations he actively participated, for so many years and to the end, he was a forceful leader, for he always had clear and decided views upon all questions which came to be considered, he had the courage and the ability to give to those views adequate expression, and he had the tact and equability of temper which enabled him not only to persuade but also to convince.

He was an exceptionally well-qualified presiding officer. He had a thorough knowledge of parliamentary law and practice and an unusual readiness in the application of his knowledge. He was instinctively fair-minded, and, therefore, he was always impartial. He had an unrivaled facility of felicitous expression, and, to those who could appreciate him, it was an intellectual pleasure to listen to the graceful speeches which he was, from time to time, accustomed to address to the Societies and Boards over which he presided.

He had a strong sense of public, as well as of private, duty, and he had no sympathy with that spirit of destructive criticism which contents itself with deploring the existence of evils which it does not try to mend.

He held public office, and he achieved results in State and municipal politics, without sacrifice of independence or loss of self-respect. In 1839 he was a member of the National Convention of the Whig Party, which nominated William Henry Harrison for election as President of the United States. From 1834 to 1837 he sat in the Common Council of the old City of Philadelphia. From 1837 to 1840 he served with credit in the Senate at Harrisburg. In 1834 he successfully accomplished, against the opposition of the most respectable conservatism of the leading citizens of that day, the introduction of street and house lighting by gas, and his

was the financial plan which made possible at that time the construction and operation of the municipal gas works. In 1853, 1854 and 1855 he actively participated in the popular efforts to secure the consolidation of the city, and his is the plan of municipal financing and accounting which is now in force, unchanged by later legislation, and largely effective to-day in the high credit of the city loans.

His was the plan under which Girard College was successfully administered as a school for orphans before the organization of the Board of City Trusts.

When in 1861 the existence of the Government of the United States and the permanency of free institutions were threatened by an armed insurrection, Mr. Fraley saw clearly the duty of the citizen, and he voiced the sentiments of that loyalty which put country above party in words which are worthy of lasting record. On 30th November, 1861, he published a letter, in which he said:

"I have both publicly and privately expressed the following opinions hitherto, and have so far seen no cause for changing them.

"First—That it is the duty of every one, with head, heart, hand and purse, to aid the general Government in putting down the rebellion, and in reducing to obedience to the Constitution and laws of the United States those who are in arms against the sovereign authority of the Union. That aid is to be cordially given, with a proper confidence that those who have been entrusted by the American people with the responsibilities of power will honestly and faithfully execute the high trusts committed to them.

"Second—That we are not engaged in a war for the prevalence of any peculiar set of political opinions, but one which is to determine by its results whether we have a National Government, binding in absolute, supreme and complete sovereignty over individuals and States for every object defined in the Constitution of the United States, or whether the nation is to be broken up by every accidental majority that may place State Legislatures in the power of traitors or fanatics.

"Third—That, having by the Constitution and various compromise laws given to the institution of slavery every protection hitherto which it could legitimately claim, and having failed thereby to avoid an appeal to a power outside of the Constitution (the appeal to arms made by the traitors of the South), it is now our duty so to deal with the slave question that it shall no longer

jeopard the peace, happiness and prosperity of the people of the United States, and that the thoughts of every patriot should be turned to measures for the gradual abolition of slavery, by compositions with loyal citizens of the South for the freedom of all persons born after a certain day, and by the speedier method of immediate freedom, with properly guarded and limited political and social rights, for the slaves of all who may continue in treason and rebellion."

Those of us who were living at that time and who remember the conflict of opinion in Philadelphia between the supporters and the opponents of the Government, and the strong personal and social influences which were arrayed in this city against a vigorous prosecution of the war, will fully appreciate the force of Mr. Fraley's frank declaration and will regard it as both patriotic and statesmanlike.

It is but right to add in this connection that no one more fully than Mr. Fraley rejoiced in later years that the wounds of war had been healed and that North and South were united under one flag in the full enjoyment of a common prosperity.

Animated by the sentiments to which he had given such clear expression, Mr. Fraley as a private citizen loyally supported the Government in all its efforts to raise men and secure money for the suppression of the insurrection, and his only regret was that his years forbade him to serve as a soldier in the field. In furtherance of his patriotic purposes he became one of the founders of the Union League, and he labored earnestly for the success of the Sanitary Commission Fair of 1864.

So long as the relative rates and costs of production of gold and silver preserved an approximate stability in the market prices of the metals Mr. Fraley, as a scientific bimetallist, advocated the double or alternating standard of value; but when the conditions changed, no one more clearly than he saw that to admit silver to free coinage would result in silver monometallism, and would inevitably be followed by national repudiation and individual bankruptcies. He, therefore, vigorously opposed the silver legislation of 1878 and 1890, and in 1891 he appeared as a representative of the Philadelphia Board of Trade before the Coinage Committee of the House of Representatives and, as the report of the Board of Trade for that year states, "going over the history of the coinage laws of the United States, from the beginning of the nation down to that

time, and giving a clear exposition of the laws of trade in relation to the action and influences of the coinage of the precious metals under the different ratios of silver to gold, he argued that inevitable danger and disaster would ensue should the bill pass authorizing the free and unlimited coinage of the silver of the whole world at the artificial standard contemplated." The result was that "the Coinage Committee, on February 20th, reported the Free Coinage bill to the House with an adverse recommendation."

One of Mr. Fraley's audience upon that occasion, Mr. William V. McKean, for so many years the honored Editor-in-Chief of the Philadelphia *Public Ledger*, and by reason of his knowledge of the financial history of the country and his trained intelligence a most competent critic of such a performance, has recently said of Mr. Fraley's speech that it covered the whole history of the silver coinage from the beginning of the Government to the date of its delivery, that it omitted nothing historically or inferentially which could elucidate the subject, and that spoken as it was by a man then eighty-seven years of age, without reference to a paper or a note, and compressed and clear, it was, in its character and in its effect upon its hearers, nothing less than marvelous.

In the memorable national campaign of 1896 Mr. Fraley assisted by his wise counsel in the educational and other efforts of the Sound Money League of Pennsylvania.

Mr. Fraley had throughout his life an exceptional facility in attracting and attaching friends to himself. To mention all of those with whom during his life he was on terms of intimate friendship would be to give the names of not only the best citizens of Philadelphia, but also the names of many distinguished men from every part of our country for the last seventy years. He drew all these men to himself by his kindness of heart, his unfailing courtesy, his sincerity, his wide and varied information and his keen sense of humor.

It is deeply to be regretted that he never committed to writing the reminiscences of men and of affairs with which he was accustomed to interest those who were fortunate enough to be admitted into intimate intercourse with him.

Mr. Fraley never undervalued the uses or the advantages of wealth, yet he did not care for wealth for its own sake, and he thought that there were other things in life better worth having, such as the truth, the steadfastness, the unselfishness, the charity and the peace of conscience that go to the making of and accompany

a fine character, and, having these better things, he had no cause to envy people who have wealth and nothing more.

In the later years of his life Mr. Fraley had to endure the physical infirmities of old age in diminished powers of locomotion and in defective eyesight, amounting almost to blindness. He bore his trials patiently and bravely, and he was spared the more distressing infirmities of old age, for he retained his clearness of mind to the last hour of his conscious existence.

It is not surprising that Mr. Fraley should have lived to years far beyond the period of the life of most men, for he inherited from his sturdy ancestry a vigorous constitution, he led a regular and a temperate life, without excesses and without undue restraint upon enjoyment, he never gave way to anger or to vain repinings, and he was uniformly cheerful and hopeful.

Mr. Fraley was born in the last year of President Jefferson's first administration and he died after President Roosevelt had succeeded to office. During his lifetime the railway, the steamship, the telegraph, and the telephone have revolutionized civilized existence; villages have grown to be great cities; our country has survived the shock of foreign and of civil war; its States, which had been separated by distance and by time, and which had been united only in name, have been welded into a nation which is to-day one of the great empires of the world. In other countries ruler after ruler has ascended the throne and has in his turn passed away; frontiers of kingdoms have been obliterated and new frontiers created; and the map of Europe, of Asia, and of Africa has been changed again and again.

To have lived through the period when these momentous events were happening, and after ninety-seven years to have died in the unimpaired enjoyment of his mental faculties, would have made any man remarkable; but Frederick Fraley, as he was known to the men who were closest to him, was remarkable not only because of his long life and not only because of the century, through almost the whole of which he had lived, but also and chiefly because of his varied knowledge, his power of expression, his steadfastness of purpose, and his many attractive qualities.

It can be said of Frederick Fraley, as of few men, that he never shrank from the performance of any duty, that he was faithful to every trust, that his continued living was a pleasure and his death a personal loss to all who knew him.

C. STUART PATTERSON.

FREDERICK AUGUSTUS GENTH.

(*Read December 6, 1901.*)

One of the sciences in which this country has made itself distinguished, especially upon the chemical side, is the science of mineralogy. In proof of this it is necessary only to mention the names of Dana, of Lawrence Smith, of Sterry Hunt, of Brush, of Shepard, of Cooke and of Genth. Among these eminent men, perhaps none of them devoted himself with more assiduity to this science than did our late colleague, Prof. Dr. Genth.

Friedrich August Ludwig Karl Wilhelm Genth was born in the village of Waechtersbach, in Hesse, on May 17, 1820. On his father's side, his family was an old Hesse-Nassau family, most of whom resided in the vicinity of Wiesbaden. His father was Georg Friedrich Genth, High Forester to Prince Issenbourg, and his mother was Karoline Amalie Genth, her maiden name having been Freyin von Schwarzenau. Her family lived in Darmstadt.

From his earliest days young Genth was taught by his father to take an interest in the phenomena of nature; whereby his powers of observation became developed and his enthusiasm awakened in the natural sciences, especially in botany, mineralogy and geology. He entered the Hanau Gymnasium at the age of sixteen, this institution being then under the direction of Dr. Schuppius. There he remained for three years, graduating on the 26th of September, 1839, fully prepared for his university course. On the 11th of November following, he matriculated at the University of Heidelberg, and came under the instruction of Gmelin in chemistry, Bischoff in botany, and Blum and Leonhard in geography, geology and mineralogy, these being the sciences to which he had already paid some attention. Owing to the pressure of family matters he left Heidelberg in August, 1841, and in the following November became a student in the University of Giessen, devoting himself mainly to chemistry and studying under Fresenius and Kopp, and particularly of Liebig. Ill health, however, compelled him to leave Giessen in April, 1843. Subsequently, in May, 1844, he entered

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the University of Marburg, studying chemistry under Bunsen and physics under Gerling. In January, 1845, he presented his dissertation to the Faculty and was graduated with the degree of Philosophiæ Doctor. The subject of this thesis was: "Beiträge zur Kenntniss des Kupferschieferhütten-processen, erläutert durch die Untersuchung der auf der Friedrichshütte bei Riechelsdorf gewonnenen Producte." Shortly afterward he became Chemical Assistant to Prof. Bunsen, and was subsequently appointed a Privat-Docent in the University. He held this position for about three years, resigning it in the spring of 1848. In the summer of that year he sailed for Baltimore, and soon after his arrival there he went to Philadelphia, where he established one of the earliest analytical laboratories in America. In the fall of 1849 he received an offer of the position of Superintendent of the Washington (now Silver Hill) mine, in Davidson county, North Carolina. This offer he accepted, giving up his laboratory in Philadelphia and removing in October to Davidson county. Here he remained until August, 1850, when he resigned this position and returned again to Philadelphia, where he reopened his analytical laboratory and devoted himself to research, to commercial analysis and to the instruction of special students in chemistry. It was in this laboratory that the chief part of his admirable work on the ammonia-cobalt bases, as well as the earlier portions of his mineralogical investigations, was done. This work of research attracted general attention, and in 1872, upon the death of Prof. Wetherill, he was tendered the Professorship of Chemistry in the University of Pennsylvania, then just entering upon the new era of prosperity consequent upon its removal to West Philadelphia. This position he at first declined because of the pecuniary sacrifice which it involved; but subsequently he accepted it with the understanding that his private work might still be carried on. He continued to hold his chair, with credit to himself and satisfaction to his colleagues, until the fall of 1888, when he severed his connection with the University and for the third time returned to his private research laboratory and to his professional work.

The earliest scientific paper published by Dr. Genth appeared in *Leonhard and Bronn's Jahrbuch* for 1842. It was entitled "Binnenconchylien lebender Arten im Kalktuff von Ahlersbach," and shows the influence not only of his father's early training in the natural sciences, but also of that of Leonhard, with whom he

studied geology in Heidelberg. A second geological paper appeared during the same year with the title "Alter verschiedener Zechsteine;" and in 1848 he published two similar papers in the *Jahrbuch*, entitled respectively "Eocene Schichten mit Beschreibung der Petrifacten" and "Miocene Geognosie des Mainzer Beckens."

It was in Giessen, however, under the influence of Liebig, and particularly in Marburg, where he studied with Bunsen, that Dr. Genth's mind received its strong bias in the direction of chemistry. Even in 1845, before taking his Doctor's degree, he published papers on "Prehnite, a Pseudomorph after Analcime;" on "Chemical Examination of Masopin, a new Gum-resin," and on "The Analysis of Various Refined Coppers." Two manuals by him—one a "Tabular Review of the More Important Reactions of Bases," and the other a similar work on the Acids—appeared soon after his graduation.

The purely chemical papers of Dr. Genth number in all thirty-one. In a letter to Liebig in 1845, and published in the *Annalen*, he called attention to an allotropic modification of nickelous oxide, occurring in the form of small, almost microscopic crystals, grayish-black in color, and having the form of regular octahedrons, on certain disks of refined copper from Riechelsdorf. In 1853 he discovered the corresponding compound of cobalt, which closely resembled it.

In *Liebig's Annalen* for 1848, Dr. Genth published a paper giving analyses of lavas from Hecla, which had been collected by Bunsen during his visit to Iceland. Four of these lavas were examined, those from Thjorsá, Háls and Efrahvolshraun and that of the eruption of 1845. In the first of these he found his first new mineral, which he named Thjorsaite.* The author concludes: (1) That these lavas differ from those of Vesuvius and Etna in that they are insoluble in hydrochloric acid, containing no material gelatinizing with this acid; (2) that the essential constituent in them has the same composition as wichtisite; and (3) that any differences in composition between them are due to the admixture of thjorsaite, chrysolite, orthoclase (?) and magnetite.

In *Erdmann's Journal für praktische Chemie* for 1846 appeared an elaborate paper by Dr. Genth on a "Chemical Examination of the Products obtained in the Metallurgy of Copper Schists." The Friedrichs plant at Riechelsdorf was especially

* Subsequently shown to be Anorthite.

studied and its products were analyzed. This paper covers forty-eight pages and is substantially his inaugural dissertation at Marburg. The immediate occasion of this investigation was the sending to Prof. Bunsen for analysis of various samples of refined copper from Sweden and Norway, together with two samples from the Riechelsdorf works; the whole coming from the Kurfürstliche Ober-berg und Salzwerke-Direction of Cassel. The examination of these coppers was turned over to Dr. Genth, and his paper is divided into six sections. The first describes the processes in use at Riechelsdorf, the second gives the analytical methods used, the third considers the products examined with their physical properties and chemical composition, the fourth gives the analysis of other coppers for comparison, the fifth the same in tabular form and the sixth states some chemico-technological conclusions. The value of this research was recognized by a letter of thanks from the Direction. It resulted in some material changes in the processes employed at the Friedrichs works.

In December, 1852, Dr. Genth read before the Academy of Natural Sciences a paper on a supposed new element which he had detected in certain small white grains associated with iridosmine and platinum from California. On treatment with hydrochloric acid, two of the metallic particles were observed to evolve hydrogen. On removing them from the liquid, they were seen under a magnifier to be mixed with gold. In color they were between tin white and steel, were malleable, but harder than tin and were soluble in nitric acid, yielding a crystalline salt. With hydrogen sulphide the solution gave a brown precipitate. Before the blowpipe on charcoal the metal fused readily, but soon became covered with a black oxide. It gave no incrustation. With borax in the outer flame it dissolved, giving a colorless bead which became opalescent on cooling. Though resembling tin, the new metal is distinguished from it by its complete solubility in nitric acid, by the brown precipitate with hydrogen sulphide and by the absence of a white incrustation before the blowpipe.

The chemical investigation, however, by which Dr. Genth is most widely known is undoubtedly that made on the ammonia-cobalt bases. His original memoir on this subject was published in Philadelphia in 1851 in *Keller and Tiedemann's "Nordamerikanischer Monatsbericht für Natur und Heilkunde,"* under the title "Vorläufige Notiz über Gepaarte Kobalt-Verbindungen." This

memoir "contained the first distinct recognition of the existence of perfectly well-defined and crystallized salts of ammonia-cobalt bases." Indeed, it would appear that no trace exists "in any earlier paper of even an idea of the existence of such a class of compounds." The results given in this paper were first obtained in 1847 in Marburg, while the author was chemical assistant to Prof. Bunsen and during the latter's absence in Iceland. They were freely communicated verbally to others and a suite of the salts obtained were deposited at the time in the laboratory at Giessen. In this early memoir Dr. Genth describes two series of salts in which cobalt oxide, conjugated with ammonia, acts as a base. To prepare these bases, ammonium chloride is added to a solution either of cobaltous chloride or sulphate, and the solution is saturated with ammonia. After standing four or five weeks in the air and the excess of ammonia has evaporated, hydrochloric acid is added to acid reaction and the solution is boiled. After some time a crystalline heavy carmine red powder is deposited, consisting of small octahedrons having the empirical formula, $Co_2O_3(NH_4)_3Cl$. Hence they must be considered as the chloride of a paired or conjugated compound, $Co_2O_3(NH_4)_3$, which plays the part of a metal. On further evaporating the mother-liquor from which the carmine red salt was obtained, an orange-yellow cobalt salt separated in crystals. "Though the analyses were from necessity not sufficiently complete and extended to fix the constitution of the bases in question, yet the fact is indisputable that this memoir contained not merely the first announcement of the existence of ammonia-cobalt bases, but also a scarcely less accurate and complete description of two of these bases than any which has since appeared."

The foregoing memoir was called by Dr. Genth a preliminary notice. But inasmuch as circumstances prevented a prompt resumption and continuation of the investigation, the field was entered by others. In 1851 Claudet described purpureocobalt; and later in the same year Frémy communicated to the French Academy "the discovery of a class of compounds containing cobalt and ammonia, and produced by the oxidation of ammoniacal solutions of cobaltous salts," claiming the discovery as his own. He "appears not to have been aware that these two bases had been described in a manner little less complete than his own two years before the appearance of his memoir."

This publication by Dr. Genth interested chemists greatly, and

on July 21, 1852, Dr. Wolcott Gibbs, then of New York, who had followed Dr. Genth's directions and had prepared these bases in his laboratory, wrote him as follows: "I enclose you herewith a small quantity of my orange-cobalt compound. . . . Please let me have your opinion of it. I think it identical with yours. Let me urge you to go on with your investigation, as it must lead to very interesting results independently of the beauty of the compounds in question." Dr. Genth's response must have been prompt, for in a second letter, written on the 26th of July, Dr. Gibbs says: "In reply to your proposition I can only say that I will willingly join you in your investigation, provided that on your return to Philadelphia you find that your engagements will prevent you from accomplishing your work alone. You ought, if possible, to have the entire credit which is justly due to you. If, however, you cannot undertake the matter alone, then I will add my labors to yours and we will publish in our joint names." Thus began the association of these two eminent men in the investigation which has since become famous. In the following November Dr. Gibbs himself discovered a new ammonia-cobalt base, obtained by passing nitrogen oxides into solutions of the compounds described by Dr. Genth. Its salts have a dark sherry-wine or brown-yellow color, and the new base differs from the others in the fact that it contains nitrogen dioxide as a coupler in addition to ammonia.

In the joint monograph of Gibbs and Genth, which was published by the Smithsonian Institution in 1856, and afterward printed in the *American Journal of Science*, the nomenclature of Frémy is substantially adopted though somewhat modified. Instead of "Roseocobaltiaque" and "Luteocobaltiaque," as Frémy proposed, the names "Roseocobalt" and "Luteocobalt" are employed for the two bases originally discovered by Dr. Genth; that of "Purpureocobalt" being given to the base discovered by Claudet, "Xanthocobalt" to that discovered by Gibbs, and "Fuscocobalt" to the one described by Frémy. The authors also followed Frémy's example in referring the colors of these substances to the chromatic scale of Chevreul. The crystallographic determinations given in the memoir were made by J. D. Dana. After describing the methods of analysis used, the monograph goes on to state at length the mode of preparation and the properties of the salts of roseocobalt, purpureocobalt, luteocobalt and xanthocobalt, together with the results of their analysis. It concludes with a theoretical discus-

sion of the rational structure of these bases, considering them "as conjugated compounds of sesquioxide, sesquichloride, etc., of cobalt, the five or six equivalents of ammonia, or of ammonia and deutoxide of nitrogen, forming the conjunct, and serving to give to the sesqui-compound of cobalt the degree of stability which it possesses in this class of bodies." This extended and elaborate research has always ranked among the highest chemical investigations ever made in this country. Several years were required to complete it, the analytical portion of the work being as difficult as it was protracted.

In 1858, in conjunction with Dr. Gibbs, Dr. Genth published a preliminary notice of a new base containing osmium and the elements of ammonia; having been led by their previous work to the study of the production of analogous compounds with other metals. On studying the action of the mixed nitrogen oxides upon ammoniacal solutions of the platinum metals, they discovered a well characterized base formed by osmium when thus treated, the salts of which crystallize well. Though noticed by Frémy in 1844, he was mistaken in its constitution, calling it osmiamide. The salts of this new base have a beautiful orange-yellow color, are quite insoluble in cold water, more soluble in hot. Their solutions decompose easily, evolving osmic acid.

Besides the admirable investigations made in pure chemistry, Dr. Genth will ever be remembered for the valuable researches which he made in chemical mineralogy. As early as 1842, while yet a student, he published in *Leonhard and Bronn's Jahrbuch* a paper on "A Pseudomorph of Prehnite after Analcime." And in 1848, there appears in *Liebig's Annalen* a paper by him containing analysis of baulite from Krabla, of phillipsite from Stempel, of chabasite from Annerode, of iron-ochre from the Alta-Birke mine, of speiss-cobalt from Reichelsdorf and of uranite from the Siebengeberge. In 1851, he announced in *Keller and Tiedemann's Monatsbericht* the discovery of tetradymite in North Carolina, of traces of platinum in Lancaster county, Pa., and of a magnetic pyrite in the same locality which contained 2.9 per cent. of nickel and which has since been made the basis of an important nickel industry. The same year he described a mineral from Texas, Pa., which he considered to be a gymnite, in which a portion of the magnesia is replaced by nickelous oxide, isomorphous with it. To this mineral

he gave the name nickel-gymnite, but Dana subsequently called it genthite.

A series of highly valuable papers, entitled "Contributions to Mineralogy," were published by Dr. Genth from time to time for several years. These papers were fifty-four in number and contained descriptions of 215 mineral species, in most cases being accompanied by analyses. Most of these contributions appeared in the *American Journal of Science*, although several were published in the *Proceedings of the American Philosophical Society* and in other serials. In a number of his later papers he was aided by S. L. Penfield, who furnished the notes on crystallography. Besides these comprehensive communications, Dr. Genth was the author of twenty-three minor contributions to chemical mineralogy, many of which contained descriptions of new species. He was the discoverer of twenty-four new minerals, all of which were so thoroughly individualized, both by chemical and by physical methods, that they took at once a position in the science which they have ever since maintained.

Dr. Genth was especially distinguished for his extensive knowledge of the chemistry of the rarer elements; and this rendered his analyses of the minerals containing these elements of great value to the science of mineralogy. His papers "On Some American Vanadium Minerals," "On the Vanadates and Iodyrites from Lake Valley, N. M.," "Examination of North Carolina Uranium Minerals," and especially the one "On Some Tellurium and Vanadium Minerals," are noteworthy. In No. VII of his "Contributions to Mineralogy," published in 1868, he gives a list of seven American tellurium minerals, of which two are new species; and in a paper published in 1874 "On American Tellurium and Bismuth Minerals," he describes native tellurium, tetradymite, altaite, hessite, petzite, sylvanite, calaverite, tellurate of copper and lead, bismuthinite and schirmerite, the latter a new mineral. Indeed, he regarded his work on tellurium minerals as among his best efforts. Nearly one-half of the new species made by him were compounds of the rarer elements.

Perhaps the most important, as it certainly was the most extended, of Dr. Genth's mineralogical investigations was that upon "Corundum: Its Alterations and Associated Minerals," the results of which were communicated to the American Philosophical Society in 1873. The paper occupies forty-six pages of the *Proceed-*

ings. In the spring of 1871, he had exhibited to the Society several peculiar crystals of corundum, altered either wholly or partly into other mineral species. "Further chemical investigation of these crystals, and of others similar to them, gave results leading to conclusions which seemed to possess interest not only for the chemist and mineralogist, but in connection with their paragenesis, to the geologist also." The largest deposits of corundum in the world are in a chromiferous serpentine or chrysolite formation and in the rocks adjoining thereto. Localities of this mineral have been developed all the way from Massachusetts to Alabama, and it will always be an interesting question by what agencies such enormous quantities of alumina could have been precipitated to form it. Especially so, since by its subsequent alteration it has given rise to many of the most widely distributed minerals and rocks. The most important deposit of corundum in the East is that at Chester, Mass., discovered by C. T. Jackson, and described mineralogically by C. U. Shepard and J. L. Smith. It consists of crystalline corundum contained in a fine scaly chlorite, and of a peculiar mixture of granular and crystallized corundum and magnetite. By far the largest deposits of corundum, however, occur in North Carolina, the corundum belt stretching southwesterly from Madison county, N. C., through Georgia into Tallapoosa county, Ala., a distance of at least two hundred and fifty miles. The first large mass of corundum was found in 1847 on the French Broad river, near Marshall. It was dark-blue in color and was associated with chlorite and margarite. The outcrop of the Culsagee mine, near Franklin, extends over thirty acres; that of the Cullakenee mine, about twenty miles southwest of this, extends over an area of three hundred acres. The corundum here is generally of a grayish-white or pale ash-gray color, with specks of sapphire occasionally. Sometimes, however, it is of a beautiful pink color, associated with andesite, zoisite, margarite, hornblende, and rarely with chlorite, spinel and tourmaline. Near Gainesville, Ga., corundum exists as a nucleus in irregular kidney-shaped masses of margarite or with a peculiar earthy mineral between isabel and flesh-red in color, intersected at intervals by veins of a fine scaly or massive margarite.

After this general survey of the geological conditions attending the occurrence of corundum, Dr. Genth proceeds to discuss the minerals which are associated with it. Corundum altered into

spinel occurs in many localities, the most interesting coming from Hindostan. The corundum crystals are from half an inch to two inches across. Many of them are completely altered, and most of them show that the alteration began at the surface and penetrated irregularly the crystals toward the centre, leaving frequently a nucleus of brownish-gray cleavable corundum. Beauxite, an aluminum hydrate mixed with ferric hydrate and a hydrous aluminum silicate, and enclosing grains of corundum, occurs abundantly in the south of France. T. S. Hunt regarded the corundum as having been produced from the beauxite by loss of its water; but Dr. Genth held the opposite view and maintained that the beauxite has resulted from the hydration of the corundum. Zoisite had been observed in the Urals by Gustav Rose as an associate of corundum. The best locality for it in this country, however, is at the Cullakenee mine, where it occurs sometimes in crystals, but generally in compact and columnar easily cleavable masses, from grayish to greenish and brownish-white in color, many of the specimens showing distinctly that it is the result of the alteration of corundum, the pink corundum being often surrounded by a thin coating of a white zoisite. Tourmaline is associated with corundum at most of the localities above given. At Unionville, Pa., black tourmaline occurs in irregular masses of different sizes, in the corundum itself as well as in the masses resulting from its alteration. Dr. Isaac Lea mentions the occurrence of a crystal of transparent green tourmaline passing through the middle of a prism of diaspore, the whole enveloped by lamellar crystals of pearly emeryllite. At the Culsagee mine there are masses of black tourmaline containing crystals of white and yellowish-white corundum disseminated through them, the particles of tourmaline crystals being intermixed with the corundum crystals and *vice versa*. Fibrolite has been long known to accompany corundum both in Europe and Asia. The variety used by the Celts in the stone age was obtained in the neighborhood of Chavagnac and Ourouze, in France, where it is associated with mica, cyanite and red and blue corundum. At Norwich, Conn., the small crystals of sapphire are completely surrounded by fibrolite. Cyanite is a very common associate of corundum, rolled masses of it occurring in Litchfield and Washington, Conn., containing corundum and diaspore. An interesting specimen from Newton, Conn., received from G. J. Brush, consists of irregularly arranged

bladed masses of a gray, bluish-white and blue cyanite ; a yellowish-white micaceous mineral occurring where the blades meet, embedded in which is diaspore containing in immediate contact with the cyanite a rounded fragment of a slightly pink corundum.

The list of these associated minerals includes staurolite, pyrophylite, damourite, ephesite, jefferisite, chlorite, margarite and lazulite, among others; and in the paper are described four new minerals: kerrite, maconite, willcoxite and dudleyite.

The conclusions reached by Dr. Genth as the result of this elaborate investigation are as follows: (1) At the period when the chromiferous and chrysolite beds were deposited a large quantity of alumina was separated and formed beds of corundum; (2) this corundum has subsequently been acted on, and in this way changed into various mineral species—spinel, fibrolite, cyanite, tourmaline, damourite, chlorite and margarite, and, perhaps, also into some varieties of feldspar; (3) a part of the products of the alteration of corundum still exist in the form of large beds of mica and chlorite slates or schists ; (4) another part has been still farther altered and converted into other minerals and rocks, such as pyrophyllite, paragonite, beauxite, lazulite, etc.

Dr. Genth gave some attention also to the chemistry of meteorites. In 1854, he described a meteorite from New Mexico, given to him by Prof. Henry, and labeled "native iron." It afforded on analysis: iron, 96.17; nickel, 3.07; cobalt, 0.42, and insoluble matter, 0.57, this latter consisting of iron, nickel and titanium. The following year he published the analysis of a fragment of one of the meteoric irons of Tucson, Mexico, presented to the Academy of Natural Sciences by Dr. Herrmann. This analysis showed the meteorite to consist of iron, copper, cobalt, nickel, chromium, alumina, magnesia, lime, soda, potash, phosphorus and silica, together with a feldspathic mineral, supposed to be labradorite. It agrees substantially with analysis by J. L. Smith of a fragment cut from one of the huge masses in that region by Lieut. John G. Parke, U. S. Engineers. A third meteoric iron was described by Dr. Genth, in 1886, from East Tennessee.

In 1874, Prof. Lesley, Director of the Second Geological Survey of Pennsylvania, appointed Dr. Genth Chemist and Mineralogist of the Survey. His acquaintance with the subject committed to him is well shown by the fact that before the close of that year he presented a "Preliminary Report on the Mineralogy of Pennsylva-

nia," which, together with an "Appendix on Hydrocarbon Compounds," by S. P. Sadtler, covered two hundred and sixty printed pages. The following year he prepared a second "Preliminary Report," covering thirty-one pages. Dr. Genth was also Chemist to the Board of Agriculture of Pennsylvania, and did much by his chemical investigations, and especially by his analysis of fertilizers and other materials, to develop the agricultural industry of the State and to maintain a high standard of excellence in all farm products.

As a man of science Dr. Genth stood among the first in this country. As a chemist, especially in analytical work, he was well-nigh without a peer, being completely familiar not only with the reactions and analytical methods of separation and determination of the ordinary elemental and compound ions, but, what is more remarkable, of the rarer and less frequently occurring ones as well. But this is not all. His scientific work was characterized by a conscientiousness and fidelity to fact which was exceptional. No labor seemed to him too great, if by it an added accuracy could be secured. His knowledge of minerals was complete. Not only did his acute vision aid his early training in recognizing their nature at a glance, but his skill in observing their physical and chemical properties gave him remarkable power in detecting new species. Moreover, his devotion to scientific accuracy was so great that most, if not all, of the differences he had with others involved questions of fact rather than of opinion. Again, his mind had acquired, by long practice, great facility in grasping the relations of structural grouping, both in salts and in minerals, and the rational formula of an ammonia-cobalt base or of a complex mineral species was at once clearly recognized from the empirical results of his analysis.

As a teacher, Dr. Genth was most successful. Apart from his complete command of the subject, he took a great interest in his good students and devoted himself assiduously to their advancement. But for those who were studiously indifferent and careless, to his credit be it said, he had but little regard. He was merciless upon fraudulent work, particularly in analysis. The reputation which he gave to his department in the University was deservedly high. The large amount of research work which he did was never allowed to interfere with his instruction, and those who were his students remained ever afterward among his best friends. His

retirement was a great loss to the University, the more so since there is reason to believe that possibly it might have been avoided.

Prof. Dr. Genth was everywhere recognized by his scientific associates as a man of rare talent. He was elected a member of the American Philosophical Society in January, 1854; he was one of the corporate members of the American Chemical Society; was elected a vice-president of this Society in 1876 and president in 1880; in 1872 he was elected a member of the National Academy of Sciences, and in 1875 a Fellow of the American Academy of Arts and Sciences in Boston. The American Association for the Advancement of Science paid him, in 1888, the high compliment of election as one of the three Honorary Fellows of the Association.

Dr. Genth's personality was most agreeable. He was cordial to his friends and associates, valued highly their society and was ever ready to give them any assistance he could render out of the storehouse of his knowledge. He was twice married, first in Europe, in 1847, to Karolina Jaeger, the daughter of the Librarian of the University of Marburg, by whom he had three children—two sons and a daughter—all of whom are yet living. In 1852, he married Minna Paulina Fischer, whom he met in Cumberland, Md.; four daughters and five sons being the issue of this second marriage. Of these four daughters and one son are still living.

Dr. Genth was rather corpulent in his habit, and in his later years went about with some difficulty, being troubled considerably with asthma. He died at his home in Philadelphia on the 2d of February, 1893, from an attack of pneumonia, being in his seventy-third year.

December 6, 1901. GEORGE F. BARKER.

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LIST OF MEMBERS

OF THE

American Philosophical Society

HELD AT PHILADELPHIA

FOR PROMOTING USEFUL KNOWLEDGE

(Founded 1743)

February, 1902.

LIST OF MEMBERS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY.

FEBRUARY, 1902.

A

	Name.	*Date of Election.*	*Present Address.*
1687.	ABBE, CLEVELAND, Prof.	July 27, 1871,	U. S. Weather Bureau, Washington, D. C
2170.	ABBOT, CHARLES CONRAD, M.D. .	Dec. 20, 1889,	Trenton, N. J.
1463.	ABBOT, HENRY L., Gen. U S.A. .	April 18, 1862,	23 Berkeley St., Cambridge, Mass.
2311.	ABBOTT, ALEXANDER C., M.D. . .	Feb'y 19, 1897,	University of Pennsylvania, Philadelphia.
1809.	ACKERMAN, RICHARD, Prof. . . .	July 21, 1876,	Stockholm, Sweden.
2128.	ADAM, LUCIEN.	Dec. 17, 1886,	41 Bard Sevigné, Rennes. France.
2457.	ADAMS, CHARLES FRANCIS, LL.D.	Feb. 15, 1901,	23 Court St., Boston.
2451.	ADLER, CYRUS, Ph.D.	May 18, 1900,	Smithsonian Institution, Washington, D. C.
1779.	AGASSIZ, ALEXANDER, Prof. . . .	April 16, 1875,	Cambridge, Mass.
1642.	AGASSIZ, MRS. ELIZABETH	Oct. 15, 1869,	Quincy St., Cambridge, Mass.
1860.	ALISON, ROBERT HENRY, M.D. .	May 3, 1878,	Ardmore, Montgomery Co., Pa.
2380.	ALLEN, ALFRED H.	May 20, 1898,	67 Surrey St., Sheffield, Eng.
1869.	ALLEN, JOEL ASAPH, Prof. . . .	Sept. 20, 1878,	Am. Museum of Natural History, New York.
1927.	AMES, REV. CHARLES G.	Jan'y 21, 1881,	12 Chestnut St., Boston, Mass.
2064.	ANDERSON, GEO L., Capt. U.S.A.	Feb'y 19, 1886,	Fort Banks, Mass.
2164.	ANGELL, JAMES B., Pres't.	Oct. 18, 1889,	Ann Arbor, Mich.
2220.	APPLETON, WILLIAM HYDE, Prof.	May 19, 1893,	Swarthmore, Pa.
2012.	ASHHURST, RICHARD L.	April 18, 1884,	2214 Walnut St., Philadelphia.
1219.	AVEBURY, The Right Hon. Lord.	July 18, 1884,	High Elms, Down, Kent, Eng.

B

	Name.	*Date of Election.*	*Present Address.*
1995.	BACHE, R. MEADE.	Jan'y 18, 1884,	4400 Sansom St., Philadelphia.
1832.	BACHE, THOMAS HEWSON, M.D .	Feb'y 2, 1877,	233 S. 13th St., Philadelphia.
2389.	BAER, GEORGE F.	Dec. 16, 1898,	518 Washington St., Reading, Pa.
2285.	BAILEY, L. H., Prof.	May 15, 1896,	Cornell University, Ithaca, N.Y.
1630.	BAIRD, HENRY CAREY	Jan'y 15, 1869,	810 Walnut St., Philadelphia.
1991.	BAIRD, HENRY M., Prof.	Jan'y 18, 1884,	219 Palisade Ave., Yonkers, N.Y.
2419.	BALCH, EDWIN SWIFT.	Dec. 15, 1899,	1412 Spruce St., Philadelphia.
2467.	BALCH, THOMAS WILLING	May 17, 1901,	1412 Spruce St., Philadelphia.
2345.	BALDWIN, JAMES MARK, Prof. . .	Oct. 15, 1897,	Princeton, N. J.
2191.	BALL, SIR ROBERT STAWELL . .	May 15, 1891,	Observatory, Cambridge, Eng.
1965.	DEBAR, HON. EDOUARD SÊVE . .	July 21, 1882,	Ramsgate, England.
1741.	BARKER, GEORGE F., Prof.	April 18, 1873,	3909 Locust St., Philadelphia.
2011.	BARKER, WHARTON	April 18, 1884,	119 S. 4th St., Philadelphia.
1902.	BARTHOLOW, ROBERTS, M.D. . .	April 16, 1880,	1525 Locust St., Philadelphia.
2119.	BASTIAN, ADOLPH, Prof.	Dec. 17, 1886,	Königgrätzerstrasse 120, Berlin, Germany.
2421.	BAUGH, DANIEL	Dec. 15, 1899,	1601 Locust St., Philadelphia.
1968.	BELL, ALEXANDER GRAHAM, Prof.	July 21, 1882,	1331 Connecticut Ave., Washington, D. C.
1802.	BELL, SIR LOWTHIAN, Bart. . . .	April 21, 1876,	Northallerton, England.
2255.	BEMENT, CLARENCE S.	May 17, 1895,	3907 Spruce St., Philadelphia.
2326.	DEBENNEVILLE, JAMES S	Oct. 15, 1897,	University Club, Philadelphia.
2264.	BERTHELOT, MARCELIN P. E. . .	May 17, 1895,	Palais de l'Institut de France, Rue Mazarin, No. 3, VIe., Paris, France.
2253.	BERTIN, GEORGES	May 17, 1895,	11 bis Rue Ballu, Paris.
1920.	BIDDLE, CADWALADER	Oct. 15, 1880,	1420 Walnut St., Philadelphia.
1831.	BIDDLE, HON. CRAIG	Feb'y 2, 1877,	2033 Pine Street, Philadelphia.
2134.	BILLINGS, JOHN S., M.D.	Feb'y 18, 1887,	40 Lafayette Place, New York.
2256.	BISPHAM, GEORGE TUCKER . . .	May 17, 1895,	1805 DeLancey Place, Phila.
2157.	BLAIR, ANDREW A.	May 17, 1889,	406 Locust Street, Philadelphia.
1554.	BLAIR, THOMAS S.	Jan'y 19, 1866,	718 Bidwell St., Pittsburg, Pa.
1669.	BLAKE, WM. PHIPPS, Prof. . . .	Oct. 21, 1870,	Tucson, Arizona.
1444.	VON BÖHTLINGK, M. OTTO, . . .	Jan'y 17, 1862,	Seeburgstrasse 35, II, Leipzig, Germany.
2235.	BONAPARTE, PRINCE ROLAND . .	Feb'y 15, 1895,	10 Ave. d'Jena 22, Paris, France.
1126.	BOYÈ, MARTIN H., Prof.	Jan'y 17, 1840,	Coopersburg, Lehigh Co., Pa.
1826.	BRACKETT, CYRUS FOGG, Prof. . .	Feb'y 2, 1877,	Princeton, N. J.
2083.	BRANNER, JOHN C., Prof. . . .	May 21, 1886,	Stanford University, Cal.
2095.	BREZINA, ARISTIDES.	May 21, 1886,	VII Siebensterngasse, 46, Vienna, Austria.
2069.	BRINTON, JOHN H., M.D	Feb'y 19, 1886,	1423 Spruce St., Philadelphia.
2433.	BROCK, ROBERT C. H.	Dec. 15, 1899,	1612 Walnut St., Philadelphia.
2445.	BROEGGER, W. C., Prof.	Dec. 15. 1899,	Christiania, Norway.
2080.	BROOKS, WILLIAM KEITH, Prof. .	May 21, 1886,	Johns Hopkins Univ., Baltimore, Maryland.
2466.	BROWN, AMOS P., Prof.	May 17, 1901,	20 E. Penn St., Germantown.
1881.	BROWN, ARTHUR ERWIN	April 18, 1879,	1208 Locust St., Philadelphia.
2394.	BROWN, ERNEST WILLIAM, Prof .	Dec. 16, 1898,	Haverford College, Pa.
2275.	BRUBAKER, ALBERT P., M.D. . .	Oct. 18, 1895,	105 N. 34th St., Philadelphia.
1547.	BRUSH, GEORGE J., Prof.	Jan'y 20, 1865,	Yale Univ., New Haven, Conn.
2376.	BRYANT, HENRY GRIER.	May 20, 1898,	Room 805 Land Title Building, Philadelphia.
2287.	BRYCE, RIGHT HON. JAMES . . .	Feb'y 15, 1895,	54 Portland Place, London, W., England.

	Name.	*Date of Election.*	*Present Address.*
2236.	BUDGE, E. A. WALLIS, Litt.D . .	Feb'y 15, 1895,	British Museum, London, Eng.
2007.	BURK, REV. JESSE Y	Jan'y 18, 1884,	400 Chestnut St., Philadelphia.
1938.	BUTLER, HON. WILLIAM	April 15, 1881,	West Chester, Pa.

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2416.	CADWALADER, JOHN	May 19, 1899,	1519 Locust St., Philadelphia.
1788.	CAMPBELL, JOHN LYLE, Ph.D., Prof.	July 16, 1875,	Crawfordsville, Ind.
1606.	CANBY, WILLIAM MARRIOTT . . .	Oct. 16, 1868,	1101 Delaware Avenue, Wilmington, Del.
2051.	CANNIZZARO, TOMSO	Oct. 16, 1885,	Santa Maria fuori cinta, Casa Roffa, Messina, Sicily.
1731.	CAPELLINI, GIOVANNI, Prof. . .	April 18, 1873,	Portovenere près Spezia, Italy.
1796.	CARLL, JOHN F., Prof.	Oct. 15, 1875,	Pleasantville, Venango Co., Pa.
1911.	CARSON, HAMPTON L., LL.D. . .	April 16, 1880,	1033 Spruce St., Phila.
2260.	CARTER, HON. JAMES C	May 17, 1895,	54 Wall Street, New York City.
1707.	CASSATT, ALEXANDER J	Oct. 18, 1872,	Haverford, Del. Co., Pa.
2147.	CASTNER, SAMUEL, JR.	Dec. 16, 1887,	3729 Chestnut St., Philadelphia.
2152.	CATTELL, J. MCKEEN, Prof. . . .	May 18, 1888,	Garrison-on-Hudson, N. Y.
1908.	CHANCE, HENRY MARTYN, M.D .	April 16, 1880,	4123 Parkside Ave., Phila.
1783.	CHANDLER, C. F., Prof.	April 16, 1875,	Columbia Univ., N. Y. City.
1778.	CHAPMAN, HENRY C., M.D. . . .	April 16, 1875,	2047 Walnut St., Philadelphia.
2132.	DE CHARENCEY, COMTE HYACINTH	Dec. 17, 1886,	25 Rue Barbet de Jouy, Paris. France.
2158.	CLARK, CLARENCE H.	May 17, 1889,	42d and Locust Sts., Phila.
1983.	CLAYPOLE, E. W., Prof.	Jan'y 19, 1883,	Pasadena, Cal.
2247.	CLEEMANN, RICHARD A., M.D . .	Feb'y 15, 1895,	2135 Spruce St., Philadelphia.
2336.	CLEVELAND, HON. GROVER . . .	Oct. 15, 1897,	Westland, Princeton, N. J.
1999.	COHEN, J. SOLIS, M.D.	Jan'y 18, 1884,	1824 Chestnut St., Philadelphia.
2429.	COLES, EDWARD	Dec. 15, 1899,	1734 Chestnut St., Philadelphia.
2305.	CONKLIN, EDWIN GRANT, Prof. .	Feb'y 19, 1897,	University of Penna., Phila.
2386.	CONVERSE, JOHN H.	May 20, 1898,	500 N. Broad St., Philadelphia.
2257.	COOK, JOEL	May 17, 1895,	849 N. Broad St., Philadelphia.
2129.	CORA, GUIDO, Prof.	Dec. 17, 1886,	2 Via Goito, Rome, Italy.
2205.	CRAMP, CHARLES H	Dec. 16, 1892,	507 S. Broad St., Philadelphia.
1836.	CRANE, THOMAS FREDERICK, Prof.	Feb'y 2, 1877,	Cornell Univ., Ithaca, N. Y.
2100.	CROOKES, SIR WILLIAM	May 21, 1886,	7 Kensington Park Gardens, London, W., England.
2391.	CROWELL, EDWARD P., Prof. . .	Dec. 16, 1898,	21 Amity St., Amherst. Mass.
2172.	CRUZ, HON. FERNANDO	Dec. 20, 1889,	57 Ave Kléber Paris, France.
2317.	CULIN, STEWART	May 21, 1897,	University of Penna., Philadelphia.

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2361.	DALL, WILLIAM H., Prof.	Dec. 17, 1897,	U. S. National Museum, Washington, D. C.
2402.	DANA, CHARLES E.	May 19, 1899,	2013 DeLancey Place, Philadelphia.
2282.	DANA, EDWARD S., Prof.	May 15, 1896,	Yale Univ., New Haven, Conn.
1806.	DANNEFELD, C. JUHLIN	April 21, 1876,	Stockholm. Sweden.
2369.	DARWIN, GEORGE HOWARD, Prof.	Feb'y 18, 1898,	Newham Grange, Cambridge, England.
1811.	DAVENPORT, SIR SAMUEL	Oct. 20, 1876,	Beaumont, Adelaide, S. Australia.

	Name.	*Date of Election.*	*Present Address.*
1557.	DAVIDSON, GEORGE, Prof.	Jan'y 19, 1866,	2221 Washington St., San Francisco, Cal.
2417.	DAVIS, WILLIAM MORRIS, Prof. .	Oct. 20, 1899,	Cambridge, Mass.
1923.	DAWKINS, WILLIAM BOYD, Prof.	Oct. 15, 1880,	Woodhurst, Fallowfield, Manchester, England.
2418.	DAY, FRANK MILES	Oct. 20, 1899,	801 Penn Mutual Building, Philadelphia.
2406.	DAY, WILLIAM C., Prof.	May 19, 1899,	Swarthmore, Pa.
2360.	DE GARMO, CHARLES, Prof. . . .	Dec. 17, 1897,	Cornell Univ., Ithaca, N. Y.
2208.	DERCUM, FRANCIS X., M.D. . . .	Dec. 16, 1892,	1719 Walnut St., Philadelphia.
2434.	DEWAR, JAMES, LL.D., Prof. . . .	Dec. 15, 1899,	The Royal Institution, London, England.
2013.	DICKSON, SAMUEL	April 18, 1884,	901 Clinton St., Philadelphia.
2206.	DIXON, SAMUEL G., M.D	Dec. 16, 1892,	1900 Race St., Philadelphia.
2108.	DOLLEY, CHARLES S., M.D. . . .	Dec. 17, 1886,	3707 Woodland Ave., Phila.
2089.	DONNER, OTTO, Prof.	May 21, 1886,	Helsingfors, Finland.
1946.	DOOLITTLE, C. L., Prof.	Oct. 21, 1881,	Upper Darby, Delaware Co., Pa.
2425.	DOUGHERTY, THOMAS HARVEY .	Dec. 15, 1899,	School House Lane, Germantown, Philadelphia.
1839.	DOUGLAS, JAMES, LL D.	April 20, 1877,	Spuytenduyvil, New York, N.Y.
1924.	DRAPER, DANIEL, Ph.D	Oct. 15, 1880,	Meteorological Observatory, Central Park, New York.
2303.	DREER, FERDINAND J.	Feb'y 19, 1897,	1520 Spruce St., Philadelphia.
1787.	DROWN, THOMAS M., Pres't . . .	July 16, 1875,	Lehigh Univ., S. Bethlehem, Pa.
1918.	DU BOIS, PATTERSON	Oct. 15, 1880,	401 S. 40th St., Philadelphia.
1878.	DUDLEY, CHARLES BENJ., Ph.D. .	Jan'y 17, 1879,	Drawer 334, Altoona, Blair Co., Pa.
2063.	DUNCAN, LOUIS, Ph.D.	Feb'y 19, 1886,	71 Broadway, New York.
1573.	DUNNING, GEORGE F.	Jan'y 18, 1867,	Farmington, Conn.
1727.	DUPONT, EDOUARD	April 18, 1873,	Royal Museum, Bruxelles, Belgium.
2227.	DUPONT, HENRY A., Col.	Feb'y 16,1894,	Winterthur, Del.
1679.	DUTTON, CLARENCE E., Maj. U.S.A.	Jan'y 20, 1871,	Morgan Park, Cook Co., Ill.
	E		
2105.	EASTON, MORTON W., Prof. . . .	Dec. 17, 1886,	224 S. 43d St., Philadelphia.
1917.	ECKFELDT, JACOB B	Oct. 15, 1880,	U. S. Mint, Philadelphia.
1825.	EDDY, H. TURNER, Prof	Feb'y 2, 1877,	University of Minnesota, Minneapolis, Minn.
2294.	EDISON, THOMAS A., Ph.D	May 15, 1896,	Orange, N. J.
2262.	EDMUNDS, HON. GEORGE F. . . .	May 17, 1895,	1724 Spruce St., Philadelphia.
1686.	ELIOT, CHARLES W., Pres't	April 21, 1871,	17 Quincy St., Cambridge, Mass.
2272.	ELLIOTT, A. MARSHALL, Prof. . .	May 17, 1895,	Johns Hopkins University, Baltimore, Md.
2313.	ELY, THEODORE N.	May 21, 1897,	115 Broad St. Station, Phila.
2356.	EMERSON, BENJ. KENDALL, Prof.	Dec. 17, 1897,	Amherst, Mass.
2368.	EMMET, W. L. R	Feb'y 18, 1898,	Schenectady, N. Y.
1981.	EMMONS, S. F., Prof.	Jan'y 19, 1883,	1721 H St., Washington, D. C.
1943.	EVANS, SIR JOHN, K.C.B.	Oct. 21, 1881,	Nash Mills, Hemel Hempstead, England.
2254.	EWELL, MARSHALL D., M.D., LL.D.	May 17, 1895,	59 Clark St., Chicago, Ill.
	F		
2234.	FENNELL, C. A. M., Litt.D. . . .	Feb'y 15, 1895,	139 Chesterton Road, Cambridge, England.
2180.	FIELD, ROBERT PATTERSON . . .	May 16, 1890,	218 S. 42d St., Philadelphia.

	Name.	*Date of Election.*	*Present Address.*
2364.	FINE, HENRY B., Prof.	Dec. 17, 1897,	Princeton, N. J.
2353.	FISHER, SYDNEY GEORGE	Dec. 17, 1897,	328 Chestnut St., Philadelphia.
2462.	FLEXNER, SIMON, Dr.	Feb'y 15, 1901,	University of Pennsylvania, Philadelphia.
1901.	FLINT, AUSTIN, JR., M.D.	April 16, 1880,	14 W. 33d St., New York, N.Y.
2197.	FORBES, GEORGE, Prof.	Oct. 16, 1891,	34 GreatGeorge St.,S.W.London.
2393.	FORD, PAUL LEICESTER.	Dec. 16, 1898,	247 Fifth Ave., New York City.
1912.	FRALEY, JOSEPH C.	April 16, 1880,	1833 Pine St., Philadelphia.
1695.	FRAZER, PERSIFOR, Dr. ès-Sc. Nat.	Jan'y 19, 1872,	928 Spruce St., Philadelphia.
2301.	FRAZIER, BENJ. W., Prof.	Dec. 18, 1896,	Lehigh Univ., Bethlehem, Pa.
2171.	FRIEBIS, GEORGE, M.D.	Dec. 20, 1889,	1906 Chestnut St., Philadelphia.
2179.	FULLERTON, GEORGE S., Rev. . .	May 16, 1890,	89, The Gladstone, Philadelphia.
1739.	FULTON, JOHN	April 18, 1873,	136 Park Pl., Johnstown, Pa.
1914.	FURNESS, HORACE Howard, LL.D.	April 16, 1880,	Wallingford, Del. Co., Pa.
2306.	FURNESS, HORACE HOWARD, JR..	Feb'y 19, 1897,	2134 DeLancey Place, Phila.
2304.	FURNESS, WILLIAM H., 3d, M.D. .	Feb'y 19, 1897,	Wallingford, Del. Co., Pa.
	G		
2459.	GARNETT, RICHARD C. B., LL.D..	Feb'y 15, 1901,	27 Tanza Road, Hampstead, London, England.
1988.	GARRETT, PHILIP C	April 20, 1883,	Logan P. O., Philadelphia.
2079.	GATES, MERRILL E., LL D	May 21, 1886,	Amherst, Mass.
1025.	GATSCHET, ALBERT S., Ph.D . . .	Oct. 17, 1884,	2020 Fifteenth St., Washington, D. C.
1897.	GEIKIE, SIR ARCHIBALD	Jan'y 16, 1880,	28 Jermyn St., London, S. W., England.
1803.	GEIKIE, JAMES, Prof.	April 21, 1876,	31 Merchiston Ave., Edinburgh, Scotland.
2067.	GENTH, F. A., JR	Feb'y 19, 1886,	103 N. Front St., Philadelphia.
2274.	GIBBS, J. WILLARD, Prof.	May 17, 1895,	121 High St.,New Haven, Conn.
1355.	GIBBS, OLIVER WOLCOTT, Prof. .	July 21, 1854,	158 Gibbs Ave., Newport, R. I.
2485.	GIGLIOLI, HENRY H., Prof. . . .	Feb'y 15, 1901,	19 Via Romana, Florence, Italy
1587.	GILL, THEODORE N., Ph.D	July 19, 1867,	Smithsonian Inst., Washington, D. C.
1800.	GILMAN, DANIEL C., LL.D	April 21, 1876,	614 Park Ave., Baltimore, Md.
2240.	GLAISHER, JAMES W. L., Sc.D. . .	Feb'y 19, 1895,	The Shola, Heathfield Road, South Croydon, England.
2233.	GLAZEBROOK, RICHARD T., F.R.S.	Feb'y 15, 1895,	23 Queen's Road, Richmond Surrey, England.
2212.	GOODALE, GEORGE LINCOLN, Prof.	Feb. 17, 1893,	10 Craigie St., Cambridge, Mass.
2292.	GOODSPEED, ARTHUR W., Prof.	May 15, 1896,	Univ. of Pennsylvania, Philadelphia.
2203.	GOODWIN, HAROLD.	May 20, 1892,	133 S. 12th St., Philadelphia.
2232.	GOODWIN, W. W., Prof.	Feb'y 15, 1895,	Cambridge, Mass.
2453.	GRAY, GEORGE, Hon.	May 18, 1900,	Wilmington, Delaware.
2222.	GREEN, SAMUEL A., M.D.	Oct. 20, 1893,	Historical Soc., Boston, Mass.
1880.	GREENE, WILLIAM H., M.D. . . .	April 18, 1879,	27 S. 5th St., Philadelphia.
2412.	GREENMAN, MILTON J., M.D. . .	May 19, 1899,	Wistar Institute, 36th and Darby Road, Philadelphia.
2155.	DI GREGORIO, MARCHESE ANTONIO	Dec. 21, 1888,	Al Molo, Palermo, Sicily.
2188.	GREGORY, CASPAR RÉNÉ, Prof. .	May 15, 1891,	Naunhofstrasse 25, Marienhöhe, Leipzig-Stotteritz, Germany.
1815.	GROTE, AUGUSTUS RADCLIFFE . .	Oct. 20, 1876,	Buffalo, N. Y.
2090.	DE GUBERNATIS, ANGELO, Prof. .	May 21, 1886,	Florence, Ital

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	Name.	*Date of Election.*	*Present Address.*
2054.	HAECKEL, ERNST, Prof.	Oct. 16, 1885,	University, Jena, Germany.
1658.	HALE, REV. EDW. EVERETT . . .	Jan'y 21, 1870,	39 Highland St., Roxbury, Mass.
1853.	HALL, ASAPH, Prof.	Jan'y 18, 1878,	South Norfolk, Conn.
1795.	HALL, CHARLES EDWARD.	Oct. 15, 1875,	Plaza Tarasquillo, Mexico, Mexico.
2396.	HALL, CHARLES M	Dec. 16, 1898,	Niagara Falls, N. Y.
2027.	HALL, LYMAN B., Prof.	Jan'y 16, 1885,	Haverford Coll., Haverford, Pa.
2194.	HAMY, E. T., Dr	May 15, 1891,	40 Rue Lübeck, Ave. du Trocadero, Paris, France.
1337.	HARDING, GEORGE	Jan'y 20, 1854,	2036 Chestnut St., Phila.
2378.	HARKNESS, WILLIAM, Prof. . . .	May 20, 1898,	90 Mercer St., Jersey City, N. J.
2136.	HARRIS, JOSEPH S.	May 20, 1887,	144 School Lane, Germantown.
2246.	HARRISON, CHARLES C., Provost.	Feb'y 15, 1895,	1618 Locust St., Philadelphia.
1827.	HART, JAMES MORGAN, Prof. . .	Feb'y 2, 1877,	1 Reservoir Ave., Ithaca, N. Y.
2365.	HATCHER, JOHN B., Prof. . . .	Dec. 17, 1897,	Carnegie Museum, Pittsburgh, Pa.
1681.	HAUPT, HERMANN, Gen	April 21, 1871,	The Concord, Washington, D.C.
1862.	HAUPT, LEWIS M., Prof.	May 3, 1878,	107 N. 35th St., Philadelphia.
2446.	HAY, JOHN, Hon.	Dec. 16, 1898,	State Dep't, Washington, D.C.
2082.	HAYES, RICHARD SOMERS, Capt .	May 21, 1886,	32 Nassau St., New York, N.Y.
2071.	HAYS, I. MINIS, M.D.	Feb'y 19, 1886,	266 S. 21st St., Philadelphia.
1985.	HEILPRIN, ANGELO, Prof	April 20, 1883,	Academy of Natural Sciences, Philadelphia.
2283.	HENDERSON, C. HANFORD, Ph.D.	May 15, 1896,	Pratt High School, Brooklyn, N. Y.
2218.	HEWETT, WATERMAN T., Prof. .	May 19, 1893,	Cornell Univ., Ithaca, N. Y.
2266.	HEYSE, PAUL, Ph.D.	May 17, 1895,	Munich, Bavaria.
2307.	HILLER, H. M., M.D.	Feb'y 19, 1897,	1510 Walnut St., Philadelphia.
2110.	HILPRECHT, HERMANN V., Prof .	Dec. 17, 1886,	403 S. 41st St., Philadelphia.
1768.	HIMES, CHARLES FRANCIS, Prof. .	Oct. 16, 1874,	Dickinson Coll., Carlisle, Pa.
2438.	HIRST, BARTON COOKE, M.D. . .	Dec. 15, 1899,	1821 Spruce St., Philadelphia.
1668.	HITCHCOCK, CHAS. HENRY, Prof.	April 15, 1870,	Dartmouth Coll., Hanover, N.H.
2355.	HOLDEN, EDWARD S., Prof. . . .	Dec. 17, 1897,	Smithsonian Institution, Washington, D. C.
2068.	HOLLAND, JAMES W., M.D. . . .	Feb'y 19, 1886,	2006 Chestnut St., Philadelphia.
2440.	HOLMES, WILLIAM H., Prof. . . .	Dec. 15, 1899,	U. S. National Museum, Washington, D. C.
1624.	HOOKER, SIR JOSEPH D., LL.D . .	Jan'y 15, 1869,	The Camp, Sunningdale, Eng.
2224.	HOPPIN, J. M., Prof.	Oct. 20, 1893,	New Haven, Conn.
2070.	HORNER, INMAN.	Feb'y 19, 1886,	1811 Walnut St., Philadelphia.
1696.	HOUGH, GEORGE W., Prof.	Jan'y 19, 1872,	N.W. University, Evanston, Ill.
1698.	HOUSTON, EDWIN J., Prof. . . .	Jan'y 19, 1872,	1809 Spring Garden St., Phila.
2346.	HOWE, HENRY M., Prof.	Oct. 15, 1897,	27 W. 73d St., New York.
2239.	HUGGINS, SIR WILLIAM, K.C.B, .	Feb'y 15, 1895,	90 Upper Tulse Hill, S.W., London, England.
1843.	HUMPHREY, H. C.	July 20, 1877,	?
2248.	HUNTER, RICHARD S.	Feb'y 15, 1895,	1413 Locust St., Philadelphia.
2373.	HUTCHINSON, EMLEN.	May 20, 1898,	Aldine Hotel, Philadelphia.

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1773.	INGHAM, WM. ARMSTRONG.	April 16, 1875,	320 Walnut St., Philadelphia.
2217.	D'INVILLIERS, EDWARD VINCENT.	May 19, 1893,	711 Walnut St., Philadelphia.

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	Name.	*Date of Election.*	*Present Address.*
2010.	JAMES, EDMUND J., Prof.	April 18, 1884,	Univ. of Chicago, Chicago, Ill.
2302.	JASTROW, MORRIS, JR., Prof. . . .	Feb. 19, 1897,	248 S. 23d St., Philadelphia.
2375.	JAYNE, HENRY LABARRE	May 20, 1898,	1826 Chestnut St., Phila.
2049.	JAYNE, HORACE, M.D.	Oct. 16, 1885,	318 S. 19th St., Philadelphia.
1954.	JEFFERIS, WILLIAM W	Jan'y 20, 1882,	442 Central Park West, New York City.
2017.	JORDAN, FRANCIS, JR.	April 18, 1884,	111 N. Front St., Philadelphia.

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1989.	KANE, ELISHA KENT.	April 20, 1883,	Kushequa, Pa.
2322.	KARPINSKY, ALEX. PETROVITCH, Prof.	May 21, 1897,	Geological Survey, St. Petersburg, Russia.
2169.	KEANE, JOHN J., Right Rev. . .	Dec. 20, 1889,	Washington, D. C.
2422.	KEASBEY, LINDLEY M., Prof. . .	Dec. 15, 1899,	Bryn Mawr, Pa.
2329.	KEEN, GREGORY B.	Oct. 15, 1897,	2320 Spruce St., Philadelphia.
2021.	KEEN, WILLIAM W., M.D. . . .	July 18, 1884,	1729 Chestnut St., Philadelphia.
2392.	KEISER, EDWARD H., Prof. . . .	Dec. 16, 1898,	Washington University, St. Louis, Mo.
2150.	KELLER, HENRY F.	May 18, 1900,	Central High School, Phila.
1723.	KELVIN, RIGHT HON. LORD . . .	April 18, 1873,	The Library, The University, Glasgow, Scotland.
2278.	KENNELLY, A. E., D.Sc	Feb. 28, 1896,	Crozer Building, 1420 Chestnut St., Philadelphia.
2392.	KNIGHT, WILLIAM A., Prof. . . .	Dec. 16, 1898,	St. Andrew's, Scotland.
1767.	KÖNIG, GEORGE A., Prof.	Oct. 16, 1874,	School of Mines, Houghton, Mich.
2424.	KRAEMER, HENRY, Prof.	Dec. 15, 1899,	145 N. 10th St., Philadelphia.
2167.	KRAUSS, FRIEDRICH S., Ph.D. . .	Dec. 20, 1889,	VII Neustiftgasse 12, Vienna, Austria.

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1694.	LAMBERT, GUILLAUME, Prof. . .	Jan'y 19, 1872,	Univ. of Louvain, Belgium.
2411.	LAMBERTON, WILLIAM A., Prof .	May 19, 1899,	University of Penna., Phila.
2377.	DE LANCEY, EDWARD F	May 20, 1898,	20 E. 28th St., New York, N. Y.
2344.	LANCIANI, RUDOLFO, Prof. . . .	Oct. 15, 1897,	2 Via Goito, Rome, Italy.
1858.	LANDRETH, BURNET.	Jan'y 18, 1878,	Bristol, Pa.
1781.	LANGLEY, SAMUEL P., LL.D . . .	April 16, 1875,	Smithsonian Institution, Washington, D. C.
1721.	LA ROCHE, C. PERCY, M.D. . . .	Jan'y 17, 1873,	1518 Pine Street, Philadelphia.
1595.	LEA, HENRY CHARLES.	Oct. 18, 1867,	2000 Walnut St., Philadelphia.
2407.	LEARNED, MARION D., Prof . . .	May 19, 1899,	University of Penna., Phila.
1986.	LEHMAN, AMBROSE E.	April 20, 1883,	711 Walnut St., Philadelphia.
2182.	LELAND, CHARLES G.	May 16, 1890,	Baring Bros. & Co., London.
2174.	LE MOINE, SIR JAMES M.	Dec. 20, 1889,	Spencer Grange, Quebec, Canada.
1934.	LEROY-BEAULIEU, M. PAUL, Prof.	April 15, 1881,	27 Ave. duBois de Boulogne, Paris, France.
1382.	LESLEY, J. PETER, Prof.	July 13, 1856,	Milton, Mass.
2085.	LEVASSEUR, EMILE, Prof.	May 21, 1886,	26, Rue Mons le Prince, Paris, France.
1415.	LEWIS, FRANCIS W., M.D.	Jan'y 20, 1860,	2016 Spruce St., Philadelphia.
2300.	LEWIS, G. ALBERT	Dec. 18, 1896,	1834 DeLancey Place, Phila.
2338.	LIBBEY, WILLIAM, Prof.	Oct. 15, 1897,	20 Bayard Ave., Princeton, N.J.

	Name.	*Date of Election.*	*Present Address.*
2432.	LIPPINCOTT, J. DUNDAS	Dec. 15, 1899,	1333 Walnut St., Philadelphia.
2312.	LISTER, THE RIGHT HON. LORD .	May 21, 1897,	12 Park Crescent, Portland Place, London, England.
1756.	LOCKYER, SIR JOSEPH NORMAN, K.C.B.	April 17, 1874,	Royal College of Science, S. Kensington, London, S. W., England.
2160.	LODGE, OLIVER JOSEPH, LL.D . .	Feb'y 15, 1901,	The University, Birmingham, England.
2435.	LOEB, JACQUES, Dr.	Dec. 15, 1899,	University of Chicago, Chicago, Ill.
1872.	LONGSTRETH, MORRIS, M.D. . . .	Sept. 20, 1878,	1416 Spruce St., Philadelphia.
2202.	LOW, HON. SETH	Feb. 19, 1892,	30 E. 46th St., New York City.
2350.	LOWELL, PERCIVAL	Oct. 15, 1897,	53 State St., Boston.
1629.	LYMAN, BENJAMIN SMITH	Jan'y 15, 1869,	708 Locust St., Philadelphia.

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2319.	MABERY, CHARLES F., Prof. . . .	May 21, 1897,	57 Adelbert St., Cleveland, O.
2107.	MACALISTER, JAMES, Pres't. . . .	Dec. 17, 1886,	119 N. 18th St., Philadelphia.
2207.	MACFARLANE, JOHN M., Prof. . .	Dec. 16, 1892,	Lansdowne, Delaware Co., Pa.
2404.	MACKENZIE, ARTHUR S., Prof. . .	May 19, 1899,	Bryn Mawr, Pa.
2363.	MCCAY, LEROY W., Prof.	Dec. 17, 1897,	Princeton, N. J.
2366.	MCCLURE, CHARLES F. W., Prof.	Dec. 17, 1897,	Princeton, N. J.
2280.	MCCOOK, HENRY C., Rev., D.D. .	Feb. 24, 1896,	3700 Chestnut St., Philadelphia.
1888.	MCCREATH, ANDREW S.	July 18, 1879,	223 Market St., Harrisburg, Pa.
1821.	MCKEAN, WILLIAM V.	Feb'y 2, 1877,	209 N. 19th St., Philadelphia.
2299.	MAGIE, WM. FRANCIS, Prof. . . .	Dec. 18, 1896,	Princeton, N. J.
2339.	MAHAN, ALFRED T., Capt. U.S.N.	Oct. 15, 1897,	160 W. 86th St., New York.
2042.	MALLET, JOHN WM., M.D. . . .	Jan'y 16, 1885,	University of Virginia, Charlottesville, Va.
1847.	MANSFIELD, IRA FRANKLIN . . .	Jan'y 18, 1878,	Cannelton, Beaver Co., Pa.
1857.	MARCH, FRANCIS ANDREW, Prof.	Jan'y 18, 1878,	Lafayette College, Easton, Pa.
2461.	MARCONI, GUGLIELMO	Feb'y 15, 1901,	The Haven Hotel, Sand Barths, Poole, Dorset, England.
2463.	MARCOVNIKOFF, VLADIMIR, Prof..	Feb'y 15, 1901.	Imp. Moskovsky, Universitet, Moscow, Russia.
1861.	MARKS, WILLIAM D., Prof.	May 3, 1878,	Westport, Essex Co., N. Y.
2078.	MARSHALL, JOHN, M.D	May 21, 1888,	1718 Pine St., Philadelphia.
2184.	MASCART, E., Prof.	Dec. 19, 1890,	176 Rue de l'Université, Paris, France.
1572.	MASON, ANDREW	Jan'y 18, 1867,	30 and 32 Wall St., New York.
2431.	MASON, OTIS T., Prof.	Dec. 15, 1899,	U. S. National Museum, Washington, D. C.
2279.	MASON, WM. PITTS, M.D., Prof. .	Feb. 28, 1896,	Rensselaer Polytechnic Institute, Troy, N. Y.
2196.	MASPERO, GASTON-CAMILLE, Prof.	May 15, 1891,	Ave. de l'Observatoire, No. 24, Paris, France.
2427.	MATTHEWS, ALBERT.	Dec. 15, 1899,	145 Beacon St., Boston, Mass.
2399.	MEIGS, ARTHUR V., M.D.	May 19, 1899,	1322 Walnut St., Philadelphia.
2456.	MEIGS, WILLIAM M	Feb'y 15, 1901,	1208 Walnut St., Philadelphia.
2115.	VON MELTZEL, HUGO, Prof. Dr. .	Dec. 17, 1886,	Koloszvar, Hungary.
2330.	MELVILLE, GEO. W , Rear Admiral.	Oct. 15, 1897,	Navy Dept., Washington, D. C.
2430.	MENDENHALL, THOMAS C , Prof.	Dec. 15, 1899,	Worcester, Mass.
2387.	MENGARINI, GUGLIELMO, Prof . .	May 20, 1898,	Rome, Italy.
2251.	MERCER, HENRY C.	Feb. 15, 1895,	Doylestown, Pa.
1903.	MERRICK, JOHN VAUGHAN.	April 16, 1880,	Roxborough, Philadelphia.

	Name.	*Date of Election.*	*Present Address.*
1947.	MERRIMAN, MANSFIELD, Prof. .	Oct. 21, 1881,	Lehigh Univ., Bethlehem, Pa.
1744.	MESSCHERT, MATTHEW HUIZINGA.	Oct. 17, 1873,	Douglassville, Berks Co , Pa.
2436.	MEYER, A. B., Prof.	Dec. 15, 1899,	K. Zoölogisches u. Anthropolo gisch-Ethnographisches Mu- seum, Dresden, Germany.
2142.	MICHAEL, MRS. HELEN ABBOTT .	May 20, 1887,	35 West Cedar St., Boston, Mass.
2423.	MILLER, LESLIE W., Prof. . . .	Dec. 15, 1899,	N. W. cor. Broad and Pine Sts., Philadelphia.
2284.	MINOT, CHAS. SEDGWICK, M.D. .	May 15, 1896,	Harvard Univ., Cambridge, Mass.
2175.	MITCHELL, HON. JAMES T. . . .	Feb'y 21, 1890,	1722 Walnut St., Philadelphia.
1461.	MITCHELL, S. WEIR, M.D	Jan'y 17, 1862,	1524 Walnut St., Philadelphia.
2267.	MONTEGAZA, PAOLO	May 17, 1895,	Florence, Italy.
2367.	MONTGOMERY, THOS. H., Jr., Prof.	Feb'y 18, 1898,	Biological Hall, Univ. of Pa., Philadelphia.
2323.	MOORE, CLARENCE B.	Oct. 15, 1897,	1321 Locust Street, Phila.
2029.	MOORE, JAMES W., M.D.	Jan'y 16, 1885,	Lafayette College, Easton, Pa.
1841.	MOREHOUSE, GEORGE R., M.D. .	April 20, 1877,	2033 Walnut St., Philadelphia.
2340.	MORLEY, FRANK, Prof.	Oct. 15, 1897,	Johns Hopkins University, Baltimore.
2409.	MORRIS, HARRISON S.	May 19, 1899,	Academy of Fine Arts, Phila- delphia.
2397.	MORRIS, ISRAEL W.	May 19, 1899,	225 So. 8th St., Philadelphia.
1976.	MORRIS, J. CHESTON, M.D. . . .	Jan'y 19, 1883,	1514 Spruce St., Philadelphia.
2454.	MORRIS, JOHN T.	Feb'y 15, 1901,	826 Drexel Building, Phila.
2265.	MORSE, EDWARD S., Prof. . . .	May 17, 1895,	Essex Institute, Salem, Mass.
1577.	MORTON, HENRY, Pres't.	Jan'y 18, 1867,	Hoboken, N. J.
2447.	MORTON, THOMAS GEORGE, M.D..	Feb'y 16, 1900,	1617 Chestnut St., Philadelphia.
2121.	MUCH, MATHÆUS, Ph.D., Prof. .	Dec. 17, 1886,	XIII Penzingerstrasse, 84, Vi- enna, Austria.
2464.	MUNRO, DANA C., Prof.	May 17, 1901,	3733 Walnut St., Philadelphia.
2192.	MUNROE, CHARLES E., Prof. . .	May 15, 1891,	Columbian Univ., Washington, D. C.
2062.	MURDOCK, J.B., Lieut.-Com. U.S.N.	Feb'y 19, 1886,	Navy Dept., Washington, D.C.
1937.	MURRAY, JAMES A. H., LL.D . .	April 15, 1881,	Sunnyside, Banbury Road, Ox- ford, England.

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2087.	DE NADAILLAC, MARQUIS.	May 21, 1886,	18 Rue Duphot, Paris, France.
2316.	NANSEN, FRIDTJOF, Prof. . . .	May 21, 1897,	Godthaab, Lysaker, Norway.
1852.	NEWCOMB, SIMON, Prof.	Jan'y 18, 1878,	16.0 P St., Washington, D. C.
1703.	NICHOLS, STARR HOYT, Rev . . .	July 19, 1872,	64 Exchange Place, New York, N. Y.
2060.	NIKITIN, SERGEJ, Prof.	Feb'y 19, 1866,	Geological Survey, St. Peters- burg, Russia.
1712.	NORRIS, ISAAC, M.D.	Oct. 18, 1872,	Fair Hill, Bryn Mawr, Pa.
2046.	NORTH, EDWARD, LL.D., Prof. .	Oct. 16, 1885,	Hamilton College, Clinton, N.Y.
2269.	NUTTALL, MRS. ZELIA	May 17, 1895,	Peabody Museum, Cambridge, Mass.

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2072.	OLIVER, CHARLES A., M.D. . . .	Feb'y 19, 1886,	1507 Locust St., Philadelphia.
2354.	OLNEY, RICHARD, Hon	Dec. 17, 1897,	23 Court Street, Boston.
2195.	OPPERT, JULES, Prof	May 15, 1891,	2 Rue de Sfax, Paris, France.
2362.	ORTMANN, ARNOLD E., Prof. . . .	Dec. 17, 1897,	8 Maple St., Princeton, N. J.

Name.	*Date of Election.*	*Present Address.*
2135. OSBORN, HENRY F., Prof.	Feb'y 18, 1887,	American Museum of Natural History, New York City.
2039. OSLER, WILLIAM, M.D	Jan'y 16, 1885,	1 West Franklin St., Baltimore, Md.

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1868. PACKARD, ALPHEUS S., Prof. . .	Sept. 20, 1878,	Providence, R. I.
1578. PACKARD, JOHN H., M.D.	Jan'y 18, 1867,	Hotel Stenton, Philadelphia.
2395. PANCOAST, HENRY S	Dec. 16, 1898,	267 E. Johnson St., Germantown, Phila.
2035. PATTERSON, C. STUART.	Jan'y 16, 1885,	1000 Walnut St., Philadelphia.
2452. PATTERSON, EDWARD, Hon. . . .	May 18, 1900,	Supreme Court, Appellate Div., 1st Dept., New York City.
2385. PATTERSON, LAMAR GRAY . . .	May 20, 1898,	P. O. Box 213, Lynchburg, Va.
1282. PATTERSON, ROBERT	April 18, 1851,	329 Chestnut St., Philadelphia.
1320. PATTERSON, THOMAS LEIPER . .	April 15, 1853,	176 Washington St., Cumberland, Md.
2213. PATTISON, ROBERT E., Hon . .	Feb. 17, 1893,	5930 Drexel Rd., Overbrook, Pa.
2357. PATTON, FRANCIS L., D.D., Pres't	Dec. 17, 1897,	Princeton, N. J.
2428. PAUL, J. RODMAN	Dec. 15, 1899,	903 Pine St., Philadelphia.
1772. PEARSE, JOHN B.	Jan'y 15, 1875,	317 Walnut Av., Roxbury, Mass.
2318. PECKHAM, S. F., Prof	May 21, 1897,	51 Quincy St., Brooklyn.
1859. PEIRCE, C. NEWLIN, D.D.S. . . .	May 3, 1878,	3316 Powelton Ave., Philadelphia.
1722. PEMBERTON, HENRY.	Jan'y 17, 1873,	1947 Locust St., Philadelphia.
2104. PEÑAFIEL, ANTONIO, Dr	May 21, 1886,	Ciudad Mexico, Mexico.
2455. PENNIMAN, JOSIAH H., Prof. . .	Feb'y 15, 1901,	4326 Sansom St., Philadelphia.
2078. PENNYPACKER, SAMUEL W., Hon.	May 21, 1886,	1540 N. 15th St., Philadelphia.
1518. PENROSE, R. A. F., M.D.	July 17, 1863,	1331 Spruce St., Philadelphia.
2059. PEPPER, EDWARD, M.D.	Feb'y 19, 1886,	El Afia, El Biar, Alger, Algerie
2333. PEPPER, GEORGE WHARTON . .	Oct. 15, 1897,	701 Drexel Building, Phila.
2383. PETTEE, WILLIAM HENRY, Prof.	May 20, 1898,	554 Thompson St., Ann Arbor, Mich.
2281. PETTIT, HENRY	Feb. 28, 1895,	5951 Overbrook Ave., Philadelphia.
2403. PHILLIPS, FRANCIS C., Prof. . .	May 19, 1899,	P. O. Box 126, Allegheny, Pa.
2295. PICKERING, EDW. C., Prof. . . .	May 15, 1896,	Harvard Univ., Cambridge, Mass.
2342. PIERSOL, GEORGE A., M.D.	Oct. 15, 1897,	Chester Ave. and 49th St., Philadelphia.
2277. PILSBRY, HENRY A., Prof.	Dec. 20, 1895,	Academy of Natural Sciences, Philadelphia.
2374. PLATT, CHARLES.	May 20, 1898,	237 S. 18th St., Philadelphia.
2127. PLATZMANN, JULIUS, Ph.D. . . .	Dec. 17, 1886,	Reichsstrasse 2, Leipzig, Germany.
2415. POINCARÉ, JULES-HENRI, Prof. .	May 19, 1899,	63 Rue Claude Bernard, Paris, France.
2053. POMIALOWSKY, JOHN, Prof. . . .	Oct. 16, 1885,	St. Petersburg, Russia.
2097. POSTGATE, JOHN P., Prof.	May 21, 1886,	Cambridge, England.
2161. POWELL, J. W., LL.D.	Oct. 18, 1889,	910 M. St., N. W., Washington, D. C.
2437. PREECE, SIR WILLIAM HENRY . .	Dec. 15, 1899,	12, Queen Anne's Gate, London, S. W., England.
2382. PRESCOTT, ALBERT B., Prof. . . .	May 20, 1898,	734 S. Ingalls St., Ann Arbor, Mich.
1780. PRIME, FREDERICK	April 16, 1875,	1008 Spruce St., Philadelphia.

	Name.	*Date of Election.*	*Present Address.*
2414.	PRITCHETT, HENRY S, President.	May 19, 1899,	Massachusetts Institute of Technology, Boston.
1758.	PUMPELLY, RAPHAEL, Prof. . . .	April 17, 1874,	Newport, R. I.
2293.	PUPIN, MICHAEL I., Prof.	May 15, 1896,	7 Highland Pl., Yonkers, N. Y.
2268.	PUTNAM, F. W., Prof.	May 15, 1895,	Peabody Museum, Cambridge, Mass.

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2131.	RADA, JUAN DE DIOS-Y DELGADO,	Dec. 17, 1886,	Calle de la Corredera baja de S. Pablo No. 12, Madrid, Spain.
2401.	RAMSAY, WILLIAM, Prof..	May 19, 1899,	University College, Gower St., W. C., London, Eng.
1736.	RAND, THEODORE D	April 18, 1873,	Radnor, Del.Co., Pennsylvania.
1849.	RANDALL, F. A., M.D.	Jan'y 18, 1878,	Warren, Pa.
2465.	RAVENEL, MAZYCK P., Dr.	May 17, 1901,	University of Pennsylvania, Philadelphia.
2388.	RAWLE, FRANCIS.	Dec. 16, 1898,	"The Lincoln," Philadelphia.
2398.	RAWLE, WILLIAM BROOKE. . . .	May 19, 1899,	230 So. 22d St., Philadelphia.
2099.	RAYLEIGH, The Right Hon. Lord.	May 21, 1886,	Terling Pl., Witham, Essex, Eng.
1784.	RAYMOND, ROSSITER W.	April 16, 1875,	99 John St., New York, N. Y.
2381.	REDWOOD, BOVERTON	May 20, 1898,	4, Bishopsgate St. Within, E. C. London, England.
2405.	REMINGTON, JOSEPH P., Prof. . .	May 19, 1899,	1832 Pine St., Philadelphia.
1889.	REMSEN, IRA, Prof.	July 18, 1879,	Johns Hopkins Univ., Baltimore, Md.
1948.	RENARD, A. F., Prof.	Oct. 21, 1881,	Acad. of Sciences, Brussels, Belgium.
1890.	RENEVIER, E., Prof.	July 18, 1879,	Univ. Lausanne, Switzerland.
2443.	RENNERT, HUGO A., Prof.	Dec. 15, 1899,	4232 Chestnut St., Philadelphia.
1816.	REULEAUX, F., Prof.	Feb'y 2, 1877,	W. Ahornstrasse 2, Berlin, Germany.
2122.	RÉVILLE, ALBERT, Prof.	Dec. 17, 1886,	21 Rue Guénégaud, Paris, France.
2315.	RHOADS, SAMUEL NICHOLSON. . .	May 21, 1897,	Audubon, N. J.
2226.	ROBERTS, ISAAC, Sc.D.	Oct. 20, 1893,	Starfield, Crowborough, Sussex, England.
1957.	ROBINS, JAMES W., Rev	April 21, 1882,	Merion, Penna.
2177.	ROGERS, ROBERT W., Prof. . . .	Feb'y 21, 1890,	Drew Theological Seminary, Madison, N. J.
1462.	RÖHRIG, F. L. OTTO, Prof.	April 18, 1862,	Pasadena, Cal.
2050.	ROLLETT, HERMANN, Ph.D. . . .	Oct. 16, 1885,	Baden bei Wien, Austria.
1907.	ROOD, OGDEN N., Prof.	April 16, 1880,	Columbia University, New York.
2198.	ROSENGARTEN, JOSEPH G.	Oct. 16, 1891,	1704 Walnut St., Philadelphia.
1964.	DE ROSNY, LÉON, Prof.	July 21, 1882,	28 Rue Mazarine, Paris, France
1838.	ROTHROCK, JOSEPH T., Prof. . .	April 20, 1877,	West Chester, Pa.
1620.	RÜTIMEYER, CARL L., Prof. . . .	Jan'y 15, 1869,	Basle, Switzerland.

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2230.	SACHSE, JULIUS F.	Feb'y 16, 1894,	4428 Pine St., Phila.
1766.	SADTLER, SAMUEL P., Prof. . . .	Oct. 16, 1874,	N.E. cor. 10th and Chestnut Sts., Philadelphia.
2148.	SAJOUS, CHARLES E., M.D	Feb'y 17, 1888,	2043 Walnut St., Philadelphia.
2358.	SAMPSON, ALDEN.	Dec. 17, 1897,	Haverford, Pa.
1563.	SANDBERGER, FREDOLIN, Prof. .	April 20, 1866,	Univ. of Würzburg, Bavaria.
2327.	SANDERS, RICHARD H.	Oct. 15, 1897,	1225 Locust St., Philadelphia.

	Name.	*Date of Election.*	*Present Address.*
1958.	SARGENT, CHARLES SPRAGUE, Prof.	April 21, 1882,	Jamaica Plain, Mass.
1780.	DE SAUSSURE, HENRI.	April 18, 1873,	Geneva, Switzerland.
2211.	SCHÄFFER, CHARLES, M.D. . . .	Feb'y 17, 1893,	1309 Arch St., Philadelphia.
2468.	SCHIAPARELLI, GIOVANNI	Feb'y 15, 1901,	Royal Observatory, Milan, Italy.
2444.	SCHLEGEL, GUSTAVE, Prof	Dec. 15, 1899,	University of Leyden, Leyden, Holland.
1864.	SCHURZ, CARL, Hon	Sept. 20, 1878,	54 William St., New York, N.Y.
1725.	SCLATER, PHILIP LUTLEY, Ph.D .	April 18, 1873,	3 Hanover Square, London, W. England.
2372.	SCOTT, C. F.	Feb'y 18, 1898,	Pittsburgh, Pa.
2112.	SCOTT, W. B., Prof.	Dec. 17, 1886,	Princeton, N. J.
1870.	SCUDDER, SAMUEL HUBBARD. . .	Sept. 20, 1878,	Cambridge, Mass.
2352.	SEE, T. J. J., LL.D.	Dec. 17, 1897,	U. S. Naval Observatory, Washington, D. C.
1704.	SELLERS, COLEMAN, Sc.D.	July 19, 1872,	3301 Baring St., Philadelphia.
2420.	SELLERS, COLEMAN, JR.	Dec. 15, 1899,	410 N. 33d St., Philadelphia.
1533.	SELLERS, WILLIAM.	April 15, 1864,	1819 Vine St., Philadelphia.
1770	SELWYN, ALFRED R. C., LL.D. .	Oct. 16, 1874,	28 Nepean St., Ottawa, Canada.
2057	SERGI, GIUSEPPE, Prof.	Oct. 16, 1885,	Università Romana, Rome, Italy
2076.	SHARP, BENJAMIN, M.D.	May 21, 1886,	Academy of Natural Sciences. Philadelphia.
1960.	SHARPLES, STEPHEN PASCHALL, Prof.	April 21, 1882,	13 Broad St., Boston, Mass.
1797.	SHERWOOD, ANDREW	Oct. 15, 1875,	Mansfield, Tioga Co., Penna.
1822.	SHIELDS, CHAS. W., Rev., LL.D..	Feb'y 2, 1877,	Princeton, N. J.
2442.	SIGSBEE, CHARLES D., Capt. U.S.N.	Dec. 15, 1899,	Navy Dept., Washington, D.C.
2149.	SINKLER, WHARTON, M.D.	May 18, 1900,	1606 Walnut St., Philadelphia.
2351.	SMITH, A. DONALDSON, M.D . . .	Oct. 15, 1897,	1820 Chestnut St., Phila.
2146.	SMITH, EDGAR F., Prof, ...	Oct. 21, 1887,	3421 Walnut St., Philadelphia.
1789.	SMITH, STEPHEN, M.D	Oct. 15, 1875,	57 W. 42d St., New York, N. Y.
2335.	SMOCK, JOHN C., Prof.	Oct. 15, 1897,	Trenton, N. J.
2141.	SMYTH, ALBERT H., Prof. . .	May 20, 1887,	5219 Archer St., Germantown, Philadelphia.
2229	SNELLEN, HERMAN, JR., Ph.D. .	Feb'y 16, 1894,	Utrecht, Netherlands.
1742.	SNOWDEN, A. LOUDON	Oct. 17, 1873,	1812 Spruce St., Philadelphia.
2009.	SNYDER, MONROE B., Prof. . . .	Jan'y 18, 1884,	2402 N. Broad St., Philadelphia
1720.	SPOFFORD, A. R., LL.D	Jan'y 17, 1873,	Library of Congress, Washington, D. C.
2348.	STEPHENS, H. MORSE, Prof. . . .	Oct. 15, 1897,	Cornell Univ., Ithaca, N. Y.
1990.	STEVENS, WALTER LECONTE, Prof.	Jan'y 18, 1884,	Lexington, Va.
1840.	STEVENSON, JOHN JAMES, Prof. .	April 20, 1877,	University Heights, New York, N. Y.
2276.	STEVENSON, SARA Y.	Oct. 18, 1895,	237 S. 21st St., Philadelphia.
2371.	STILLWELL, L. B.	Feb'y 18, 1898,	Buffalo Ave., Niagara Falls, N.Y.
2168.	STOKES, SIR GEORGE G., Bart . .	Dec. 20, 1889,	Lensfield Cottage, Cambridge, England.
2094.	SUESS, EDUARD, Prof.	May 21, 1886,	K. K. Geologische Reichsanstalt, Vienna, Austria.
2258.	SULZBERGER, MAYER, Hon. . . .	May 17, 1895,	1303 Girard Ave., Philadelphia.
2092.	SZOMBATHY, JOSEF, Prof.	May 21, 1886,	Burgring 7, Vienna, Austria.

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2328.	TATHAM, WILLIAM	Oct. 15, 1897,	1811 Walnut St., Philadelphia
2243.	TAYLOR, ISAAC, Rev., LL.D . . .	Feb'y 15, 1895,	York, England.

	Name.	*Date of Election.*	*Present Address.*
2098.	TEMPLE, RICHARD CARNAC, Lt.-Col.	May 21, 1886,	Port Blair, Andaman Islands, Bengal, India.
2289.	TESLA, NIKOLA	May 15, 1896,	46 E. Houston St., New York.
2006.	THOMAS, ALLEN C., Prof.	Jan'y 18, 1884,	Haverford, Pa.
1993.	THOMPSON, HEBER S.	Jan'y 18, 1884,	Sheafer Build'g, Pottsville, Pa.
1726.	THOMPSON, SIR HENRY, Bart. . .	April 18, 1873,	35 Wimpole St., Cavendish Square, London, England.
1807.	THOMSON, ELIHU, Prof.	April 21, 1876,	Swampscott, Mass.
1909.	THOMSON, WILLIAM, M.D.	April 16, 1880,	1426 Walnut St., Philadelphia.
2052.	IM THURN, EVERARD F.	Oct. 16, 1885,	Pomeroon River, Georgetown, British Guiana, S. A.
1530.	THURY, A., Prof.	April 15, 1864,	Univ. of Geneva, Switzerland.
2176.	TIMMINS, SAMUEL	Feb. 21, 1890,	Arley, near Coventry, England.
2123.	TOPINARD, PAUL, Prof.	Dec. 17, 1886,	105 Rue de Rennes, Paris, France.
2249.	TOWER, CHARLEMAGNE, JR., Hon.	Feb'y 15, 1895,	U. S. Embassy, St. Petersburg, Russia.
2418.	TREVELYAN, GEORGE OTTO, Rt. Hon. Sir	May 19, 1899,	8 Grosvenor Crescent, S. W., London, England.
2288.	TROWBRIDGE, JOHN, Prof.	May 15, 1896,	Harv. Univ., Cambridge, Mass.
2441.	TRUE, FREDERICK WILLIAM, Dr.	Dec. 15, 1899,	U. S. National Museum, Washington, D. C.
2024.	TRUMBULL, HENRY C., Rev., D.D.	July 18, 1884,	1031 Walnut St., Philadelphia.
1973.	TSCHERMAK, GUSTAV.	Oct. 20, 1882,	Universität, Vienna, Austria.
2321.	TSCHERNYSCHEW, THEODORE, Prof.	May 21, 1897,	Geological Survey, St. Petersburg, Russia.
1529.	v. TUNNER, PETER R., Prof. . . .	April 15, 1864,	Leoben, Austria.
1983.	TURRETTINI, THEODORE, Prof. .	Dec. 19, 1883,	Geneva, Switzerland.
2166.	TUTTLE, DAVID K., Ph.D.	Oct. 18, 1889,	U. S. Mint, Philadelphia.
2163.	TYLER, LYON G., Hon., Pres't . .	Oct. 18, 1889,	Williamsburg, Va.
2138.	TYSON, JAMES, M.D	May 20, 1887,	1506 Spruce St., Philadelphia.

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2185.	UNWIN, WILLIAM C., Prof.	Dec. 19, 1890,	7 Palace Gate Mansions, London, England.

V

2400.	VAUCLAIN, SAMUEL M.	May 19, 1899,	1513 Green St, Philadelphia.
2325.	VAUX, GEORGE, JR.	Oct. 15, 1897,	404 Girard Building, Phila.
2045.	DE VERE, M. SCHELE, Prof. . . .	Oct. 16, 1885,	University of Virginia, Charlottesville, Va.
1475.	VIRCHOW, RUDOLPH, Prof. . . .	Oct. 17, 1862,	Universität, Berlin, Germany.
1670.	VOSE, GEORGE L., Prof.	Oct. 21, 1870,	Concord, Mass.
2186.	VOSSION, LOUIS	Dec. 19, 1890,	Consulate of France, Bombay India.

W

2034.	WAGNER, SAMUEL.	Jan'y 16, 1885,	Greenbank Farm, West Chester, Pa.
1748.	WAHL, WILLIAM H., Ph.D. . . .	Jan'y 16, 1874,	15 S. 7th St., Philadelphia.
2331.	WALCOTT, CHARLES D., LL.D. .	Oct. 15, 1897,	U. S. Geological Survey, Washington, D. C.

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2156.	WARD, LESTER F., LL.D.	May 17, 1889,	1464 Rhode Island Ave., Washington, D. C.
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2448.	WRIGHT, WILLIAM ALDIS, LL.D .	Feb'y 16, 1900,	Trinity College, Cambridge, England.
2244.	WUNDT, WILLIAM, Prof.	Feb. 15, 1895,	Leipzig, Germany.
2426.	WURTS, ALEXANDER JAY	Dec. 15, 1899,	Westinghouse Elec. and Mfg. Co., Allegheny, Pa.
1932.	WURTS, CHARLES STEWART, M.D.	Jan'y 21, 1881,	1701 Walnut St., Philadelphia.
2061.	WYCKOFF, A. B., Lieut. U. S. N. .	Feb'y 19, 1886,	Navy Department, Washington, D. C.

Y

1904.	YARNALL, ELLIS	April 16, 1880,	420 Walnut St., Philadelphia.
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